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STRONG (L. A.). **Report of the Chief of the Bureau of Entomology and Plant Quarantine, 19**[39]**–40.**—128 pp. Washington, D.C., U.S. Dep. Agric., 1940.

An account is given of work on insect pests and their control in the United States during the year ending June 1940, some of which has already been noticed.

During investigations on the biological control of *Pseudococcus comstocki*, Kuw., which has been reported with increasing frequency since 1934 in apple orchards from South Carolina to Ohio and Connecticut [*cf. R.A.E.*, A **24** 722; **28** 487], a search was made for parasites in Japan, where the mealybug appears to be controlled by natural enemies and is not an important pest. Six species of parasites were found, and shipments of 166,000 larvae of five of them, comprising three undescribed species of *Allotropa*, one species of *Anagyrus* and one of *Leptomastix*, were dispatched to the United States. Two of the species of *Allotropa* were liberated in heavily infested orchards in Virginia, West Virginia and Ohio. The sixth parasite was *Clausenia purpurea*, Ishii, which is already present in certain Eastern States [*cf.* **29** 196] and is being recolonised in Ohio, from which it appears to be absent. Experiments on the mass liberation of *Cryptolaemus montrouzieri*, Muls., are being conducted with stock obtained from California.

In studies on methods of determining the periods during which adults of the overwintered generation of the codling moth [*Cydia pomonella*, L.] emerge and oviposit, the use of cages and bait-traps and the periodic examination of apple trees for fresh empty pupal cases gave fairly consistent results for the first and peak emergences; emergence from the trees continued for some time after it was completed in the cages, however, and regular examination of certain branches showed that many eggs were laid during periods when only a few adults were trapped, and that most were laid after the peak captures were passed. Surveys of parasitism of the oriental fruit moth [*Cydia molesta*, Busck] on peach showed that *Macrocentrus ancylivorus*, Rohw., continues to be the most important species over much of the area surveyed; *Angitia* (*Inareolata*) *molestae*, Uch., still persists in some localities in the Midwest, where it was last released in 1937, but appears to be dying out there as elsewhere. Following the discovery of the pear psylla [*Psylla pyricola*, Först.] in Washington and Idaho in 1939 [**29** 48], an organisation was set up to deal with the problem. Although light infestations were found in additional orchards early in 1940, the infested area is still fairly well isolated, and the ultimate eradication of this Psyllid is considered possible.

About 86 per cent. of the cocoons of the grape berry moth [*Polychrosis viteana*, Clem.] in vineyards in Ohio were found to occur in a soil strip 18 ins. wide directly under the vines, where they are difficult to reach during cultivation. Only about 18 per cent. of the moths are prevented from emerging by normal spring cultivation, and although this percentage was increased to 45 by autumn ploughing, the method employed has serious horticultural disadvantages. A spray programme including four applications of thiodiphenylamine (phenothiazine) gave good control of a moderate infestation but was a little less satisfactory in severely infested vineyards; there was comparatively little spray residue on the fruit, whereas a programme including four applications of a tank-mixed nicotine bentonite gave outstanding

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control but left a very heavy residue. A high degree of control of the pecan nut case-bearer [*Acrobasis caryae*, Grote] in Florida was given by late summer sprays of lead arsenate or calcium arsenate combined with Bordeaux mixture, which lessens the risk of injury to the foliage, but the treatment is more beneficial to the following than to the current crop. Work on cold storage against insect pests of dried fruit showed that the periods of exposure likely to be lethal at 32°F. are less than 27 days for adults of the saw-toothed grain beetle [*Oryzaephilus surinamensis*, L.] and less than 15 days for the larvae, less than 28 days for larvae of the Indian meal moth [*Plodia interpunctella*, Hb.], and more than 100 days for larvae of the raisin moth [*Ephestia figulilella*, Gregson] ; the corresponding periods for a temperature of 36°F. are less than 28, less than 20, less than 50 and more than 115 days.

In experiments on the control of California red scale [*Aonidiella aurantii*, Mask.] on *Citrus* in California, extracts of rotenone-containing plants were more toxic in oil sprays than nicotine, the most effective combination being cubé resins in a soluble oil. An oil emulsion in which the emulsifier was glue was less effective than a soluble oil when both oils were used alone or with the addition of cubé resins. A further advantage in the use of soluble oils is that the solution of the resins can be added to the oil just before the spray tank is filled ; light medium oils were more effective in combination with the resins than heavy oils. In field trials, the percentage mortalities of adults on grey wood and on fruit were increased from 36 to 76 and from 82 to 96, respectively, by the addition of cubé resins to the spray. From counts of 500 adult females of the Florida red scale [*Chrysomphalus ficus*, Ashm.] in two localities in Florida, it was estimated that 32 per cent. survived a minimum temperature of 27·5°F. and 16 per cent. one of 23°F. in January ; despite the reduction in infestation resulting from the severe weather, the dropping of old infested leaves, and the gathering of fruit, enough survived on most trees to reinfest the leaves and young fruit.

The milky disease of larvae of the Japanese beetle [*Popillia japonica*, Newm.] increased in importance and appeared in a number of additional localities in the south of the infested area. In one district in north-eastern Maryland, an autumn population of 38 larvae per sq. ft. was reduced to about 6 per sq. ft. by the following June, and of these, two-thirds were affected by the disease, which occurred naturally. In investigations on the fumigation of balled and potted nursery stock with methyl bromide against various stages of *P. japonica*, the adults were less, and the eggs more, resistant than the larvae. Treatments that appeared only partly effective against the larvae after exposure for 2–4 hours gave complete mortality when the stock was kept at approximately the fumigation temperature for 3 days, but the results were poor when the temperature was much reduced after exposure. The distribution of the parasites, *Tiphia popilliavora*, Rohw., and *T. vernalis*, Rohw., was continued during the year.

There was no marked change in the amount of loss to pines caused by bark-beetles in the western States [*cf.* **28** 574]. Studies extending over four seasons indicated that the Black Hills beetle [*Dendroctonus ponderosae*, Hopk.] is usually able to survive the minimum temperatures occurring throughout its normal distribution. Lethal low temperatures appear to occur once in seven years in forests of ponderosa pine [*Pinus ponderosa*] and less often among limber and lodgepole pines [*P. flexilis* and *P. contorta*]. In Colorado, estimated mortalities of 50 and 29 per cent.

resulted from minimum temperatures of −34°F. in February 1933 and −15°F. in November 1938, respectively. The resistance of overwintering larvae to cold increased from October and was highest from mid-December until March; it then decreased, reaching a minimum during the first part of May. During winter, larvae in *P. flexilis* and *P. contorta* can survive air temperatures 5–12°F. lower than those in *P. ponderosa*, but in spring and autumn the resistance among larvae in all three trees is the same. In mid-October, mortality among larvae removed from the bark of *P. ponderosa* first occurs at 10°F. and none survives at −1°F. In mid-December, mortality begins at about −13°F. and is complete at −31°F. In tests with various materials applied to the bark of elm logs to protect them from attack by insects, sprays containing fuel oil or kerosene and orthodichlorobenzene, monochloronaphthalene or naphthalene were the most effective; when applied in May, they prevented attack by *Scolytus multistriatus*, Marsh., *Hylastes* (*Hylurgopinus*) *rufipes*, Eichh., and certain Longicorns during the rest of the year, and when applied during September–April, inclusive, they considerably reduced attack during the following season. Trials of chemical sprays for treating green logs and timber against attack by ambrosia beetles were begun in Louisiana in 1934 but did not give satisfactory results until 1939, when several cheap though complex compounds, including dichloro-diphenyl oxide, gave effective protection. Attack can also be prevented by stacking the timber on end for 12–15 days to reduce the moisture content, which may be as high as 45–52 per cent., sufficiently to render the wood unattractive to the beetles.

The status of the European spruce sawfly [*Gilpinia polytoma*, Htg.] showed little change. Heavy infestations occurred in northern and eastern Maine and the heavily infested areas in southern Vermont and southern New Hampshire increased in size, but mortality among severely defoliated trees has so far been low, since it is chiefly the old leaves that are destroyed and enough young ones are left to maintain the trees. Disease caused heavy larval mortality where the larvae were very abundant and markedly reduced infestation; 10–60 per cent. of the overwintering cocoons were destroyed by mammals and predacious insects. Over 100 million adults of the Eulophid parasite, *Microplectron fuscipenne*, Zett., were reared and released in the infested region during the year. Studies on the bionomics of *Cylindrocopturus longulus*, Lec., which recently caused conspicuous damage to young Douglas firs [*Pseudotsuga taxifolia*] in a widespread outbreak in western Washington, were concluded. There is one generation a year. The adults begin to oviposit in green twigs from 1st August until 15th September, but survive the winter, and fertile eggs are deposited during the following season. The weevil was parasitised by 13 species of Hymenoptera, and parasitism, food-plant resistance, and larval competition are considered to be the most important controlling factors. It is normally of minor importance, but may be a potential pest, especially in plantations on poor sites and gravelly soil.

In Porto Rico, attempts to use Spanish cedar [*Cedrela*] for reforestation have been abandoned owing to the severity of attack by the shoot-borer, *Hypsipyla grandella*, Zell.; following the elimination of Spanish cedar, this Pyralid is increasing rapidly in plantations of mahogany. About 98 per cent. of the seeds of the West Indian satinwood tree [*Zanthoxylum flavum*] in Porto Rico are destroyed by *Apion martinezi*, Mshl.

In the course of surveys for the gipsy moth [*Lymantria dispar*, L.], cages were employed to attract the males. A total of 8,122 were set up in 73 towns in Vermont, New York, New Jersey and Pennsylvania, and of these 148 in 25 towns attracted 274 moths and resulted in the discovery of 98 infestations (9,008 egg-clusters). It was possible to collect only 81,299 female pupae during the summer ; 35,910 females emerged, and 1,197 charges of attractant [*cf.* **19** 493 ; **21** 459] were prepared from them and placed in cold storage for use during the summer of 1940.

In the summer of 1939, populations of the lesser migratory grasshopper [*Melanoplus mexicanus*, Sauss.] averaged about 50 per sq. yard in an area in eastern Montana, but between 20th June and 15th July nearly all the grasshoppers left, most flying to the north-west in the direction of the prevailing wind. Some settled in north-central Montana, where oviposition began about 1st August and continued until 15th September, but many crossed into Alberta and Saskatchewan. Sodium fluosilicate, used at a concentration of 3 lb. per 100 lb. bran or other carrier, provided an excellent substitute for sodium arsenite in baits ; it gave good mortality in field trials in autumn, but it should be distributed before oviposition begins. Baits mixed with oil or water were successfully distributed by aircraft, those mixed with oil appearing to be rather more suitable. Under some conditions, drier, lighter baits, which are more suitable for rapid and economical distribution from the air, were effective at rates as low as 5 lb. per acre. Nymphs of the Mormon cricket [*Anabrus simplex*, Hald.] fed on poison baits whenever the temperature was high enough for activity and migration ; they fed at slightly lower temperatures than the adults. The speed of migration of nymphs was about 100 yards in 50 minutes.

In tests of dusts for the control of adults of the white-fringed beetle [*Pantomorus leucoloma*, Boh.], all forms of cryolite used gave more than 90 per cent. mortality in field cages, and several kinds did not injure the foliage of ground-nuts (*Arachis hypogaea*) and field peas ; on cotton, however, calcium arsenate was more effective. The larval population in plots of ground-nuts that had previously been dusted to control the adults was 22·9 per sq. yd. in autumn, compared with 77·4 in undusted plots. All larvae to a soil depth of 16 ins. were killed by fumigation with carbon bisulphide at the rate of 11cc. per sq. ft. in June, when the soil temperature exceeded 76°F., and this method was the most effective where complete mortality, regardless of plant injury, was desired. Larval populations were reduced as effectively in fields left fallow only during the period of adult activity, from May until November, as in fields left fallow for the whole year ; populations diminished rapidly on abandoned farm lands but were still present after two years of complete fallow. More larvae occurred in ground-nuts and in maize intercropped with velvet beans [*Stizolobium*] than in pure cultures of maize or cotton. Winter oats, which produce many fibrous roots, were not seriously injured by heavy infestations of larvae, but tobacco and sugar-cane planted in infested soil were severely damaged. Localised infestations, heavy enough to cause injury to crops, were found to occur in Chile. Field observations showed that cereals sown on soil kept in clean fallow during the previous growing season consistently escaped major infestation by the pale western cutworm [*Agrotis orthogonia*, Morr.]. Deep furrows ploughed across the path of larvae entering uninfested grain fields from infested stubble fields were of some value as barriers.

As a result of experimental fumigations of grain in all the types of bins commonly found on farms, it was established that satisfactory control of insects is afforded by carbon bisulphide at the rate of 3 U.S. gals. per 1,000 bushels of grain, except when excessive evaporation, due to strong wind and too high a grain temperature, caused heavy loss of fumigant. A mixture of ethylene dichloride and carbon tetrachloride (3 : 1) is free from risk of fire and explosion, but 6 U.S. gals. were required per 1,000 bushels of grain. Wheat in sacks stacked in large piles in tightly constructed warehouses can be successfully fumigated with methyl bromide at the rate of 1 lb. per 1,000 cu. ft. space, and this fumigant was also satisfactory for clean rice at atmospheric pressure. Fumigation at the rate of $1\frac{1}{2}$ oz. per 1,000 lb. rice at 70°F. gave complete mortality in brewers' rice in clean sacks after exposure for 4 hours, and a dosage of $\frac{1}{2}$ oz. was effective with an exposure of 12 hours. Complete control of insects was obtained when $3\frac{1}{2}$ million pounds of rice, stored in burlap bags in a gas-tight concrete warehouse of 365,000 cu. ft. capacity, was fumigated with methyl bromide at the rate of 0·85 oz. per 1,000 lb. rice for a period of 42 hours and fans were used to distribute the gas. Exposure for 72 hours at a temperature of 95°F. to hydrocyanic acid gas, carbon bisulphide, and ethylene dichloride at rates lethal to insects did not adversely affect the germinating power of maize having a moisture content of 10–16 per cent. ; maize with a moisture content of 12–16 per cent. showed some injury after exposure to chloropicrin at the rate of 3 lb. to 1,000 bushels for 12 hours [*cf.* **29** 210].

Considerable reductions in the numbers of *Lygus* spp. attacking seed crops of lucerne in Arizona and in the percentage of damaged seed resulted when all growing lucerne was destroyed in late winter and the first hay crop was cut and the seed crop started at approximately the same time in all the fields. Studies in southern Arizona also showed that there is a direct correlation between the numbers of *Lygus* spp. present on the flowering stalks of beet and the percentage of non-viable seed produced, and that, in addition to *Lygus* spp., Say's plant bug [*Chlorochroa sayi*, Stål] and *Thyanta custator*, F., which are common in this area, can reduce both the percentage of viable seed produced and the weight of the seed per unit volume, although they did not reduce the quantity of seed or the percentage of large seeds. Aphids did not affect the viability of the seed, but appeared to reduce the quantity, while the false chinch bugs [*Nysius ericae*, Schill.], even in numbers as great as 500 per plant, had little effect on the plants or on the seed produced. The results of experiments in southern California on the control of the tomato fruitworm [*Heliothis armigera*, Hb.] confirmed the value of cryolite dusts, which were more effective than calcium arsenate and about equal in effectiveness to baits containing natural cryolite and maize meal or bran (1 : 10), scattered over the plants by hand [*cf.* **28** 575].

In the summer and early autumn of 1938, the tobacco moth [*Ephestia elutella*, Hb.] was found infesting tobacco in growers' pack houses in many widely separated areas in North Carolina and Virginia. In general, damage was fairly light, though in some houses it resulted in the loss of almost all the newly harvested and cured crop. Further infestations were discovered in 1939, and evidence was obtained that the large warehouses were the source of infestation, which was spread by the migration of the adults or by the movement of infested scrap tobacco for use as a fertiliser. Since infestation can persist from year

to year in pack houses, careful sanitation should be practised, especially where neighbouring storage warehouses have been disinfested and screened. In studies on the importance of tobacco plant beds as a source of infestation by the tobacco flea-beetle [*Epitrix parvula*, F.], the number of adults emerging from an open bed to which control measures were not applied averaged 432·6 per sq. ft. in June. Emergence was reduced by 70 per cent. by destroying all the plants left in the bed when transplanting was completed ; other measures include the application of insecticides at regular intervals while the plant beds are in use, and the use of beds constructed and covered to exclude the beetles during the early part of the season.

Ants tending root Aphids on cotton were effectively controlled by sweetened baits containing thallium acetate and thallium sulphate, placed in small aluminium cans about 10 ft. apart along every third row of plants, and, at less cost, by one composed of ½ lb. tartar emetic, 1 U.S. quart cane syrup and 1 lb. sugar mixed with 1 U.S. gal. water and absorbed by sawdust or cotton-seed hulls, which was distributed in small handfuls under the plants. Sawdust was less satisfactory as a carrier than cottonseed hulls, 12 lb. of which is sufficient to absorb about 2½ U.S. gals. bait and to treat 1½–2 acres of cotton. The best results were obtained when the bait was applied on warm sunny days following cool nights when the soil had been packed by rain and the plants were just appearing above ground. Since root Aphids feed on many common cultivated and wild plants, they are abundant on cotton following crops in which weeds develop during the autumn and winter. Most of the damage by the bollworm [*Heliothis armigera*] to cotton in experimental plots in Texas was caused by larvae of the second generation. Dusts of lead arsenate and cryolites containing 97, 90, 83 and 30 per cent. sodium fluoaluminate gave almost equal control and increased the yield of seed cotton by 110–126 per cent., whereas a mixture of cryolite and sulphur containing 16·5 per cent. sodium fluoaluminate increased it only by 29 per cent. Dusts containing barium fluosilicate and calcium arsenate gave increased yields of 64 and 56 per cent., respectively. The ability of the pink bollworm [*Platyedra gossypiella*, Saund.] to overwinter in New Mexico, was demonstrated for the first time when larvae in infested bolls under hibernation cages survived the winter of 1939–40. An experiment showed that delayed planting of cotton decreases initial infestation, because adults emerge before squares are available for the larvae, but increases the population entering hibernation in autumn since the crop matures later. Evidence was obtained that breeding almost certainly continues throughout the winter in the lower Rio Grande Valley under normal conditions and if food is available. Some larvae entered diapause as early as July. Larvae in diapause occurred in old bolls and locks of cotton on plants and on the soil surface or buried in the soil throughout the winter and as late as April, but no larvae were found in loose cocoons in the soil. Although about 50 species of malvaceous plants occur in this region, only okra [*Hibiscus esculentus*] and *Malvaviscus drummondi* were infested.

Parasites imported into the United States from France during the year comprised *Triaspis thoracicus*, Curt., against the vetch Bruchid [*Bruchus brachialis*, Fhs.], and *Meigenia mutabilis*, Fall., against the asparagus beetle [*Crioceris asparagi*, L.]. A rearing stock of *Microbracon kirkpatricki*, Wlkn., for use against *Platyedra gossypiella*, was imported from Egypt, and one of the local strain of *Tiphia popilliavora*,

for use against *Popillia japonica*, from Korea. A consignment of *Lydinolydella metallica*, Tns., a parasite of larvae of the Mexican bean beetle [*Epilachna varivestis*, Muls.] and other species of *Epilachna* was received from Brazil. Importations from Porto Rico comprised an additional stock of the São Paulo strain of the Amazon fly [*Metagonistylum minense*, Tns.] against the sugar-cane borer [*Diatraea saccharalis*, F.], and *Coelophora inaequalis*, F., against the sugar-cane Aphid [*Sipha flava*, Forbes].

Chemical investigations on insecticides and the removal of spray residues are briefly reviewed.

CLAUSEN (C. P.). **Entomophagous Insects.** Med. 8vo, x+688 pp., 257 figs., 47 pp. refs. London, McGraw-Hill Pub. Co. Ltd., 1940. Price £2 9*s*.

With the growth of interest in the method of biological control of insect pests, the literature dealing with insect parasites and predators has assumed formidable proportions. Important contributions have been made by workers in many different countries, so that the student has access to only a small fraction of the published material. The author has therefore sought to make this work a comprehensive survey of the biology and host relations of the various kinds of entomophagous insects, designed to be of value to investigators engaged in field work on insect parasitology and the biological control of insect pests.

The book is divided into 16 main sections, each dealing with a separate insect Order; that dealing with the Hymenoptera occupies about half of it. Families are considered separately, individual species being cited as examples, and those containing parasites, in which the host relationships are highly specialised and the immature stages show considerable morphological adaptation to their mode of life, are treated at greater length than those containing the more generalised predators. Full references are given for the information cited in the text.

LAMBERT (R.). **Les insectes forestiers du Québec en 1940.**—*Forêt québecoise* **3** no. 2 pp. 29-47, no. 3 pp. 29-45, 9 figs., 3 refs.; also as *Contrib. Minist. Terres Forêts Québec*, Serv. Ent., no. 10, 38 pp. Quebec, 1941.

In 1940, the survey of insect pests of forests in Quebec [*cf. R.A.E.*, A **29** 36] was still further extended, nearly 5,000 samples comprising over 150,000 individuals being collected. The organisation of the survey is described [*cf.* **29** 311], and notes, arranged under the trees attacked, are given on the occurrence, and in some cases control by natural enemies or insecticides, of about 50 insects, many of which, however, do not appear to be of great economic importance. The only species dealt with in detail is *Gilpinia* (*Diprion*) *polytoma*, Htg., on spruce. Cloudy, wet weather in spring greatly retarded the development of the larvae, which were late in making their cocoons, so that the first adult did not emerge in laboratory cages until 22nd July and adults of the second generation formed only a very small fraction of the total population. The distribution of the sawfly was much the same as in 1939, but the intensity of infestation was somewhat less in some districts, notably the Gaspé Peninsula, though it increased in some more western areas. The average number of larvae found per

tree throughout the Province was 47, as compared with 53 in 1939 [*cf.* **29** 36]. The author considers that these averages are comparable, though they are based on collections by a large number of individuals and represent only a small fraction of the actual number of larvae per tree. The larval disease observed in 1939 [*cf.* **29** 38] increased in intensity in 1940, particularly in the Gaspé, and destroyed all the larvae on some trees. During the year, 151,400,000 individuals of the Eulophid parasite, *Microplectron fuscipenne*, Zett., were liberated, bringing the total released since 1933 to over 392,000,000.

Henry (H. K.) & Heit (C. E.). **Flight Records of *Phyllophaga* (Coleoptera : Scarabaeidae).**—*Ent. News* **51** no. 10 pp. 279–282. Philadelphia, Pa., 1940.

In experiments with light-traps carried out in 1934–39 in a forest-tree nursery in New York State [*cf. R.A.E.*, A **29** 421], adults of 14 species of *Lachnosterna* (*Phyllophaga*) were taken. Tables are given showing the numbers taken in each year, the longest flight periods observed, the periods during which 90 per cent. of the six commonest species were taken and the percentages of males and females among these. Females of *L.* (*P.*) *anxia*, Lec., and *L.* (*P.*) *fusca*, Fröl., were taken in slightly greater numbers than males. The main flight periods of the three most important species, *L.* (*P.*) *tristis*, F., *L. anxia*, and *L. fusca* [*cf. loc. cit.*], occurred in May and June.

Haseman (L.) & McLane (S. R.). **The History and Biology of the Juniper Midge (*Contarinia juniperina* Felt).**—*Ann. ent. Soc. Amer.* **33** no. 4 pp. 612–614, 1 pl. Columbus, Ohio, 1940.

Dead tip growth on native red cedars [*Juniperus virginiana*] caused by the recently described Cecidomyiid, *Contarinia juniperina*, Felt [*cf. R.A.E.*, A **28** 67, 547] was first observed in Missouri in the late autumn of 1936 and became more severe in 1937 and 1938. This Cecidomyiid has one generation a year and overwinters in the larval stage in the top three inches of litter and soil under the trees ; pupation occurs in spring, and the adult emergence begins at the end of April. Mating, oviposition and death usually occur within a few days of emergence, but a few adults are still on the wing during the first days of June. The eggs are laid under the base of the needles of the new growth near the tip of the twigs and hatch in about a week. The larvae bore under the base of the needles and make a cavity in the soft twig. They do not become fully fed until October or November, when they drop to the ground, though a few mature live larvae occur in the twigs throughout the winter and even in the spring. In early summer the injury appears as a watery blister, but by late summer or early autumn, many of the twigs are severed and the tips begin to dry and bleach. A severely infested tree turns brown during late autumn, especially on the south exposure, and most of the brown tips break off during the winter. After two or three years of severe injury, most of the fine growth is removed from the trees.

C. juniperina appears to be confined to junipers. In Missouri, it attacks *J. virginiana*, with its horticultural varieties, and *J. scopulorum* the most severely and other species to a less extent, but has not been found on the upright or pfitzer varieties of Chinese juniper [*J. chinensis*]. It is widely distributed in Missouri, and has also been

observed in Kansas, Nebraska and Kentucky, but probably has a much wider distribution throughout the United States. It appears to be unaffected by normal winter cold or prolonged high summer temperatures, but infestation is reduced by prolonged cold rains during the period when the adults are emerging and ovipositing. The only effective natural enemy is *Platygaster pini*, Fouts, which parasitises the larvae and destroyed large numbers in 1938 and 1939.

Bliss (C. I.). **The Relation between Exposure Time, Concentration and Toxicity in Experiments on Insecticides.**—*Ann. ent. Soc. Amer.* **33** no. 4 pp. 721–766, 11 figs., 22 refs. Columbus, Ohio, 1940.

The following is the author's summary. Not infrequently the dosage in a toxicological research depends upon both the concentration of a poison, such as of a fumigant, and the length of time it acts. Experiments in which one dosage factor is held constant and the other varied over a suitable range yield dosage-mortality curves which can be computed as straight lines in terms of probits and logarithms [*cf. R.A.E.*, A **22** 440 ; **23** 493]. In other experiments the exposure time killing " 100 " or some other percentage of insects may be determined directly for each concentration. Since a three-factor solution of the problem must embrace all combinations of two terms in which the third is held constant, the relation between concentration (C) and exposure time (t) has been examined first for a single level of mortality.

An equation suitable for a large majority of cases is that proposed by Ostwald, $(C-C_o)^n t=k$, where C_o is a threshold concentration and n and k are constants. In the many experiments where C_o seems to equal zero, log t can be plotted against log C as a straight line. The toxicity of the fumigant is directly proportional to the slope of this line (b_2) and inversely proportional to its position (a_2), the numerical values depending upon the mortality involved but the relation holding both for " 100 per cent." kills, shown to be a relatively indefinite term, and for lower levels. Equations are given for computing b_2 and a_2 and their standard errors and for testing the significance of any apparent curvature from the computed line. Experiments on the toxicity of hydrogen sulphide to the flour mite and of sodium arsenate to mosquito pupae served as numerical examples.

Concave curvature in the line relating log-time to log-concentration may be assigned to a measurable threshold concentration, C_o, which should be determined. By definition it is the concentration which satisfied the equation, so that log-time plotted against the logarithm of the effective concentration or log $(C-C_o)$ is a straight line. Successive values are assigned to C_o, each leading to a new series of log $(C-C_o)$ against which the log-times (z) can be replotted. The process is continued until the relation between z and log $(C-C_o)$ can be fitted as well by the linear regression coefficient, b_2, as by a polynomial equation with both a linear and a quadratic coefficient. A method is described for determining this value from three preliminary estimates and for computing the standard errors of the final C_o, b_2 and a_2. An experiment on the toxicity of hydrocyanic acid to the cockroach has been used for illustration.

An extension of the analysis to three factors requires that the mortality be measured at several exposure times for each of three or more concentrations, and a dosage-mortality curve determined for each concentration in terms of probits (y) and log-time (z). Two

possibilities are considered. The simpler is that all curves comprising the series are substantially parallel, so that a single combined slope, b_c, can be computed. The other parameter for each curve, the log-LD50 [logarithm of the median lethal dosage] or z at $y=5$, is plotted against the logarithm of the effective concentration (x) and fitted with the straight line $z+b_2x-a_2=0$. Then the general equation for the mortality in probits expected with any given combination of time and concentration is $y=(5-b_ca_2)+(b_cb_2)x+b_cz$. The equation is solved graphically, corrected by computation and its validity tested by an analysis of variance. The procedure has been illustrated by experimental data on the toxicity of ethylene oxide to *Calandra granaria* and of carbon dioxide to *Tribolium confusum*.

The other possibility is that the slope of the dosage-mortality curve changes with the concentration. In this case the two parameters defining the susceptibility of an insect population at each concentration, the standard deviation s or the reciprocal of slope and the mean or z at $y=5$, are plotted separately against the logarithm of the effective concentration. Both diagrams are fitted by straight lines to obtain the two equations $s_c=a_1+b_1x$ and $z+b_2x-a_2=0$ at $y=5$, which are then combined into the single expression

$$y=\frac{(5a_1-a_2)+(5b_1+b_2)x+z}{a_1+b_1\,x}$$

Four parameters are required here to compute the mortality expected with different combinations of x and z. The successive stages in computing the equations and an analysis of variance for testing its agreement with the original data are described. An experiment on the toxicity of hydrocyanic acid to *Calandra granaria* served to illustrate the procedure.

Nel (R. G.) & Mathew (G. E. A.). **The toxic Effect of Pyrethrum and Aliphatic Thiocyanate upon the Eggs and Larvae of** *Ephestia elutella* **Hbn. and the Adults of** *Sitophilus oryzae* **L. and** *Bruchus chinensis* **T.**—*Ent. Mem. Dep. Agric. For. S. Afr.* **2** pt. 4 pp. 41–51, 3 pls., 6 refs. Pretoria, 1940.

A detailed account is given of experiments in the laboratory on the toxicity to eggs and larvae of *Ephestia elutella*, Hb., and adults of *Calandra* (*Sitophilus*) *oryzae*, L., and *Bruchus chinensis*, L., of atomised sprays of butyl carbitol thiocyanate or pyrethrum extract, with a highly refined white mineral oil or a deodorised kerosene as the carrier. Three concentrations of each insecticide (0·2, 0·5 and 0·8 per cent. total pyrethrins and 5, 10 and 15 per cent. thiocyanate) were used in all tests except those on *B. chinensis*, and the quantity of spray applied was also varied in all tests except those on eggs of *Ephestia*, which were exposed to a mist. The laboratory technique is described, and the results are given in a series of tables showing the concentrations used with each carrier, the numbers of insects sprayed, the percentages of mortality and of control (allowing for natural mortality), the percentage mortality given by the carriers alone and that among untreated insects, and the amount of spray applied.

The following are the authors' conclusions: In its ovicidal action, the thiocyanate is superior to pyrethrum. When applied directly to the

larvae of *Ephestia* and the adults of *C. oryzae* and *B. chinensis*, pyrethrum gave decidedly better control than the thiocyanate. An oil carrier of low viscosity and high volatility as used in these experiments gave better control than a heavier oil carrier. This was also apparent when the two carriers were applied without the toxic ingredients.

Nel (R. I.). **The Validity of the Bait-trap Method of Spray Timing in Codling Moth Control.**—*Ent. Mem. Dep. Agric. For. S. Afr.* **2** pt. 5 pp. 55–76, 5 graphs, 37 refs. Pretoria, 1940.

The reliability of bait-traps for estimating the abundance and activity of *Cydia* (*Carpocapsa*) *pomonella*, L., and the amount of oviposition by it is discussed, and observations made in pear orchards in South Africa are recorded. The bait-mixture used was 1 lb. sugar, ¼ oz. yeast and 12 pints water, and the catches were examined every two days. It is concluded from the results that the use of bait traps may give a reasonably good indication of the numbers of moths actively in flight, but that the amount of oviposition cannot be estimated from the numbers of moths caught, without consideration of the sex-ratio and the reproductive condition of the females. Criteria used in classifying females into physiological ages according to their reproductive condition are described. The catches included females of all ages, from fresh unmated to old spent individuals that had paired six times. The small proportion of fresh or young females during the peaks of catch suggests that the peaks of oviposition occur earlier, and theoretical considerations based on the accumulation of population following waves of moth emergence support this suggestion. The bait-trap alone seems inadequate as a method of timing sprays, and it seems desirable to make more use of data on moth emergence. In practice it would appear that the so-called critical sprays should be applied as soon as the peaks of catch occur, instead of 5–10 days later.

Bishop (H. J.). **The Bush Locust** (*Phymateus leprosus*) **in the Eastern Cape Province.**—*Bull. Dep. Agric. For. S. Afr.* no. 208, 8 pp., 2 pls. (1 col.). Pretoria, 1940.

Phymateus leprosus, F., occurs in the wild bush and scrubland of the coastal belt of South Africa and at times invades farm lands, damaging *Citrus*, pumpkins and other crops. Descriptions of all stages and figures of the older hoppers and adults are given. The eggs are laid, probably in the ground, from June to August and do not hatch until March–May of the following year. The development of the hoppers extends over 12–13 months, and the adults live for several months, so that the full cycle occupies two years. The hoppers of all ages are gregarious and cluster together on low shrubs; they also undertake migrations in close narrow columns. Both hoppers and adults emit an offensive smell when caught and are not eaten by birds. A Sarcophagid fly was bred from adults, but it is not known whether it was a true parasite. The methods of control recommended include beating the hopper clusters with wire brooms and spraying them with an emulsion made of ½ lb. soap chips, dissolved in ½ gal. boiling water, to which ½ gal. motor crankcase oil is added, the whole being diluted in 2 gals. water.

Pescott (R. T. M.). **Weevil Damage to stored Grain.**—*J. Dep. Agric. Vict.* **38** pt. 11 pp. 517–518, 551, 2 figs. Melbourne, 1940.

Protect stored Wheat from Weevils. How Wheat Growers can help.—*Agric. Gaz. N.S.W.* **51** pt. 11 pp. 597–600, 3 figs. Sydney, 1940.

In view of the prospect that large quantities of wheat will be stored in Australia owing to present conditions, these papers, which are intended primarily for farmers in Victoria and New South Wales, outline the precautions necessary to prevent the grain from becoming infested by insects before it is taken from farms for storage or export and when it is in transit. The points dealt with include the cleaning or other treatment of old sacks to be used for storage and the need for keeping new season's grain entirely separate from old. It is well known that dry grain is less susceptible to infestation than damp grain, and it is pointed out in the first paper that, as initial infestation of grain does not occur in the field in Victoria, as it does in some other parts of Australia and elsewhere, wheat should be allowed to ripen thoroughly before harvesting. It is stated in the second paper that there is no direct evidence that infestation of wheat in the ear occurs in New South Wales. Unless grain in harvesting machinery is thoroughly cleaned out after harvest or prior to the new harvest, it constitutes a primary source of infestation of clean wheat from the field. The best time for such cleaning is immediately after harvest, before insects have had time to spread to the grain in the machine. Barley and oats are equally subject to infestation, and similar care should be taken for their protection.

Waterhouse (G. A.). **The Small Cabbage White Butterfly.**—*Aust. Mus. Mag.* **7** no. 8 pp. 255–256, 2 figs. Sydney, 1941.

Pieris rapae, L., spread from Victoria to the adjoining part of New South Wales in 1940 [*R.A.E.*, A **29** 290], and an example was taken near Sydney in January 1941. It is thought that this butterfly must have been introduced into Australia as the result of the presence of infested cabbages and cauliflowers on a ship arriving from a country where it already occurs. It is probable that the larvae pupated in the ship and the adults flew ashore when it was in port.

Caldwell (N. E. H.). **Brown Paper Bunch Covers for the Control of Banana Rust Thrips.**—*Qd agric. J.* **54** pt. 6 pp. 428–429. Brisbane, 1940.

Since brown paper is still being used in Queensland by banana growers for covers for the fruit bunches, mainly as a protection for the fruit in winter but also as a substitute for hessian covers [*cf. R.A.E.*, A **26** 211] for the control of the banana rust thrips [*Scirtothrips signipennis*, Bagn.], experiments were carried out to determine the best kind of paper for this purpose. In general, they showed that the heavier the paper the better its weather-resisting properties, and also that unglazed papers are superior in this respect to glazed ones. Double tubes, made by slipping one tube inside another, withstood adverse weather conditions in the plantation remarkably well. Thus, double tubes of a glazed paper of which the D/C rating (a trade designation based on the weight of a ream of sheets each 20×30 ins.) was 30 lb. were all intact after covering bunches for 20 weeks between

February and June in a very exposed plantation and were still intact after a further 13 weeks' exposure from June to September on a second series of bunches in the same plantation, whereas a considerable proportion of single tubes of the same paper was badly torn 8 weeks after being fitted to bunches in February. Single tubes of this paper were considered suitable only for very sheltered areas. Brown and other papers treated with plastic bitumen, creosote or linseed oil were unsatisfactory.

Tubes are rather susceptible to tearing by wind. Bags resist tearing better for the first few weeks, but once a break has been made by the fruit bursting through the paper they deteriorate more rapidly than the tubes. Completely closed bags complicate the application of dusts and the determination of fruit maturity. It has been suggested that the tubes should be tied at the bottom to minimise movement in the wind, but the value of this has not been fully investigated.

It is recommended as a result of the work that in most plantations single tubes of unglazed brown paper of a D/C rating of not less than 30 lb. but preferably of 35 lb. should be used, while double tubes of unglazed brown paper of not less than 26 lb., or of glazed paper of not less than 30 lb., should be used in exposed plantations. The bunches should be covered as soon as they are thrown ; a 2 per cent. nicotine dust should be applied to the bunch at covering, and three further applications should be made at weekly intervals. The additional cost involved in using double instead of single tubes is largely offset by the fact that at least one layer and in most cases both layers of such tubes can be used a second time. Single tubes can seldom be used again.

The Control of Pink Wax Scale in Citrus Orchards.—*Qd agric. J.* **54** pt. 6 p. 476. Brisbane, 1940.

A very brief account is given of the bionomics of the pink wax scale [*Ceroplastes rubens*, Mask.] on *Citrus* in Queensland [*cf. R.A.E.*, A **24** 35, 134]. Although infestation by this Coccid is not particularly harmful in itself, it so weakens the affected parts as to predispose them to injury from other causes. Sprays should be applied when the typical young scales are about the size of a pin's head, the most satisfactory consisting of 5 lb. high-grade laundry soap, 12–14 lb. clean fresh washing soda (sodium carbonate) and 75 gals. water. A spray of 1½ lb. clean fresh washing soda in 4 gals. water is very effective but inclined to injure the tree. A spray of resin, caustic soda (sodium hydroxide) and fish oil [*cf.* **22** 712] is also effective and kills much older scales than either of the others. It should not be used, however, at temperatures above 90°F. Fumigation with hydrocyanic acid gas is fairly effective.

Holmes (F. O.). **Handbook of Phytopathogenic Viruses.**—Demy 8vo vii+221 pp. multigraph. Minneapolis, Minn., Burgess Publ. Co., 1941. Price $2·00.

In view of the great increase in knowledge of phytopathogenic viruses, a need has arisen for a system of classification capable of clearly indicating present conceptions, but flexible enough to permit easy assimilation of changes. Since the author considers that existing

systems of classification of plant viruses tend to conceal rather than display demonstrated relationships, he here proposes to extend to them the system of binomial nomenclature. He recognises two classes of the division PHYTOPHAGI of the kingdom VIRA, *viz.*, SCHIZOPHYTOPHAGI (including the bacteriophages, which are dealt with in a supplement) and SPERMATOPHYTOPHAGI, the viruses that are pathogenic in seed plants. The latter include ten families, each comprising a single genus, with species and varieties. These are listed in systematic order, with appropriate common names and others that have been applied to them, and information on plants that are susceptible and insusceptible to infection by them, geographical distribution, the symptoms produced in the host plants, methods of transmission (including insect vectors), serological and immunological relationships, thermal inactivation, filterability and control. Supplements include lists of the many plants that are susceptible to infection by *Chlorogenus callistephi* (aster yellows), *C. eutetticola* (sugar-beet curly top), *Marmor tabaci* (tobacco mosaic), *M. cucumeris* (cucumber mosaic), *Lethum australiense* (tomato spotted wilt) and *Annulus tabaci* (tobacco ring-spot), those not susceptible to infection by *M. tabaci*, and viruses of which too little is known for a place to be assigned to them in the system.

HAMILTON (C. C.), Ed. **Entoma. A Directory of Insect Pest Control.** — 4th edn, 197 pp. New Brunswick, N. J., Eastern Br. Amer. Ass. econ. Ent., 1941. Price $1·00.

The lists in this fourth edition of a directory already noticed [*cf. R.A.E.*, A **23** 601] have been considerably expanded. In addition to those previously mentioned, it now contains lists of moth-proofing testing laboratories, firms engaged in vacuum fumigation, dusting and spraying from aircraft and the production of motion-picture films of insects, trade-marked insecticides, fungicides and adjuncts, insecticide and fungicide manufacturers, the agricultural experiment stations of the United States and entomological societies in the United States and Canada. The introductory survey of insecticides includes notes on several materials that have shown promise in recent research.

HOOD (C. E.). **Life-history and Control of the Imported Willow Leaf Beetle.**—*Circ. U. S. Dep. Agric.* no. 572, 9 pp., 3 figs., 6 refs. Washington, D.C., 1940.

The Chrysomelid, *Plagiodera versicolora*, Laich., all stages of which are described, has of recent years become very prevalent on willow in many parts of New England, and is also abundant in New York, New Jersey, Pennsylvania, Maryland and Delaware. It has been recorded on poplar, but in New England it feeds only on willow, *Salix nigra* and *S. alba* var. *vitellina* being preferred, although *S. babylonica* and *S. lucida* are also attacked. Both adults and larvae feed on the foliage, but whereas the larvae skeletonise the leaves by feeding on both surfaces, more often on the lower, the adults usually feed only on the superficial tissue. Considerable feeding has been observed on *S. lucida*, but it was confined to the lower surface of the leaves. The foliage turns brown after heavy larval feeding, and in cases of severe infestation, trees have been observed to be entirely brown by the middle or end of June.

An account is given of studies on its bionomics carried out in an insectary in eastern Massachusetts during 1933–34. There are three generations and a partial fourth during the year, with considerable overlapping. The overwintered adults resume activity during late April and early May, and those of the first, second and third generations emerge at approximately monthly intervals. Adults of the third generation, which appear in early August, feed heavily for a few days, but by the end of the month practically all have entered hibernation. A very few deposit eggs from which the partial fourth generation develops. Tables show the maximum, minimum and average durations of the immature stages in 1933, the duration of the immature stages for each generation in 1934, the average number of eggs deposited by single females of each generation, and the seasonal occurrence of the various stages of each generation in 1934. The maximum number of eggs deposited by a single female was 357 ; most eggs were deposited by females of the overwintering generation, the number subsequently decreasing with each succeeding generation. Mated pairs of adults obtained from a collection made on 7th May were all dead by 10th August when kept in glass vials, and by 4th August in a large glass-topped tray ; in similar experiments, adults of the first generation survived until 4th September and 11th October, and those of the second until 12th September and 15th October.

P. versicolora is controlled to some extent by the Pteromalid, *Schizonotus sieboldi*, Ratz., which parasitises the larvae and emerges from the pupae [*cf. R.A.E.*, A **28** 16], and extremely cold winters are fatal to adults hibernating in quarters that are not well protected. In experiments on artificial control in 1933, heavily infested trees were sprayed on 8th June with lead arsenate at rates of 3 and 5 lb. per 100 U.S. gals. water, with fish oil as an adhesive, and the trials were repeated on similar trees on 22nd June. In 1934, further trials were made on 28th May and 22nd June with sprays containing 3, 4 and 5 lb. lead arsenate per 100 U.S. gals. water and the adhesive. Satisfactory results were given by the sprays containing 4 and 5 lb. lead arsenate in both early and late applications ; those containing 3 lb. were less effective when applied early, but almost as effective as the stronger sprays in the later applications. In 1934, more rain fell while the spray residues from the early applications were on the trees than after the later ones, although the total rainfall for June, July and August was considerably lower than usual. On the basis of these experiments, it is recommended that willows should be sprayed with 4 lb. lead arsenate per 100 U.S. gals. between 25th May and 25th June. If treatment is postponed until after this date, 3 lb. per 100 U.S. gals. can be used, although considerable injury to the foliage will have been done by this time. An adhesive (fish oil or linseed oil) should be incorporated in the spray at the rate of 4 fl. oz. per lb. of poison in the spray tank.

DeLong (D. M.). **Studies of Methods and Materials for the Control of the Leafhopper** *Empoasca fabae* **as a Bean Pest.**—*Tech. Bull. U.S. Dep. Agric.* no. 740, 63 pp., 25 figs., 54 refs. Washington, D.C., 1940.

The following is substantially the author's summary. Field-plot tests on the control of *Empoasca fabae*, Harr., as a pest of beans were carried out in Ohio in 1926–28 and in Florida and Ohio in 1932–33.

Excellent immediate toxicity was obtained with various pyrethrum sprays, but they lacked residual effect. Bordeaux mixture showed no immediate toxicity but had excellent residual effect and a delayed toxicity. Nicotine and oil sprays gave only partial control.

Leafhoppers placed on plants previously treated with Bordeaux mixture died in 4–5 days, while those covered with this material and placed on untreated plants were not killed. Those confined to unsprayed surfaces of sprayed leaves died in 5–10 days with symptoms of Bordeaux poisoning. The lack of a contact factor and the slow effect on the insects gave a strong indication that they were obtaining copper compounds in some form from the plant liquids on which they fed or were affected by a physiological product of the plant induced by applications of Bordeaux mixture. Bordeaux poisoning was characterised in the leafhoppers by a replacement of the normal green by a yellowish colour, and by weakening, inactivity, and motor paralysis, accompanied by partial or faulty ecdysis. Small nymphs are more readily killed than large ones or adults.

Leafhoppers were fed through membranes upon various dilutions of copper sulphate with or without the addition of a 5 per cent. sugar solution, and upon various dilutions of calcium hydroxide. The copper sulphate solutions, both with and without sugar, showed high toxicity to the leafhoppers and were 10–20 times as toxic as lime solutions. When leafhoppers obtained copper compounds only by feeding on plants of which the roots were placed in copper solutions, they were easily killed by the plant juices. The leaves of these plants were removed and copper was found in the expressed juices. Lime sprayed on plants had no toxic effect on the leafhoppers. The supernatant liquid of Bordeaux mixture was not toxic to them and showed no soluble copper when tested by a method that should detect copper at dilutions as great as 1–50,000. A relatively small percentage of copper sulphate in the Bordeaux spray solution is effective for leafhopper control.

Bordeaux residue applied to filter papers in glass funnels and exposed to atmospheric conditions for several weeks failed to release soluble copper to the rain-water that passed over it, but rain-water collected from plants sprayed with Bordeaux mixture showed positive tests for soluble copper. Sugar solutions and expressed plant juices readily dissolved soluble copper compounds from dry Bordeaux residue through permeable membranes. Distilled and tap water gave only negative results. Refractometer readings of plant sap from bean and potato plants showed that as a rule the sugar content of sprayed plants is lowered for 1 or 2 days after treatment below that of untreated plants, but that it soon rises above that of the latter, and usually remains higher for 2 or 3 weeks. The plant physiology is changed by the presence of Bordeaux mixture in such a way that a temporary resistance is produced in the plant, which produces toxicity to the leafhoppers feeding upon it for several days after treatment.

Insectary tests of various preparations of sulphur were made by spraying the leafhoppers, spraying the plants and insects together, spraying the plants and placing the leafhoppers on them immediately or 1–26 days afterwards, and exposing the preparations in shallow dishes directly under infested plants covered by bell jars. Only slight toxicity was shown by the first method, and in the case of the materials exposed under the plants, the mortality was not greater than in the controls. When the insects fed on sprayed plants

immediately or up to 26 days after spraying, the mortality was high as compared with the controls.

In the field tests, pyrethrum extract killed practically all the leafhoppers present at the time it was applied, but those hatching from the eggs in the leaf tissue caused a rebuilding of the population. When tobacco dust was mixed with sulphur, the reduction in populations was no greater than when sulphur was used alone. A dust of copper sulphate and lime was of little value under Ohio conditions and was not comparable with the Bordeaux mixture or some of the sulphur-pyrethrum combinations. Bordeaux mixture used extensively on field plots gave excellent reductions of the populations and showed a residual value somewhat greater than that of any other material used, but when Bordeaux mixture (3 : 4½ : 50) was combined with a 2 per cent. white oil the residual value was greatly reduced. Among the sulphur materials, flotation-sulphur paste (8 lb. to 50 U.S. gals. water), wettable dry sulphur spray (5 lb. to 50 U.S. gals. water), and dry-mix spray (8 lb. flowers of sulphur, 4 lb. hydrated lime, ½ lb. calcium caseinate and 50 U.S. gals. water) gave excellent reduction of populations. Dusting sulphur gave more gradual but good control. Liquid lime-sulphur gave fair control, but caused some plant injury and showed a lack of residual effectiveness during a part of the time. Sulphur dust used with pyrethrum containing either 0·5 or 1 per cent. pyrethrins in combinations of 90 : 10 or 95 : 5 usually showed very good killing qualities and a good residual value. When sulphur dust was used with pyrethrum containing 0·05 per cent. pyrethrins in combinations of 1 : 1 and 3 : 1, both combinations possessed good toxic qualities, but the latter was superior to the former as regards residual value.

Stitt (L. L.). **Three Species of the Genus *Lygus* and their Relation to Alfalfa Seed Production in southern Arizona and California.**—*Tech. Bull. U.S. Dep. Agric.* no. 741, 19 pp., 2 figs., 12 refs. Washington, D.C., 1940.

The following is based on the author's summary. *Lygus hesperus*, Knight, *L. elisus*, Van D., and *L. pratensis oblineatus*, Say, are distributed throughout the main lucerne seed-producing areas of Arizona and California, where they seriously reduce the yield of seed. The chief damage has been to the floral parts of the plant prior to the formation of seeds, and to the immature seeds. These Capsids breed on various wild and cultivated plants, and large numbers have been taken on lucerne, cotton, sugar-beet, *Sisymbrium irio* and *Chenopodium murale*; the last two are important for spring breeding, but other native food-plants have not influenced the population of *Lygus* in the lucerne fields.

The Capsids prefer the tender terminal parts of lucerne, particularly the buds and flowers. Significant or highly significant positive correlations between estimates of *Lygus* populations and flower fall in the six lucerne seed crops produced in southern Arizona and southern California during 1935, 1936 and 1937 indicate that the Capsids do severe injury to the flowering parts. Cage experiments showed that they cause the seeds to turn brown and in many cases to shrivel up and become papery. The average number of seeds destroyed per bug was 23·35. Samples from three seed crops in 1936 and 1937 showed significant positive correlations between the percentage of

brown seeds and the populations of *Lygus*. High populations occurred on lucerne in June, July, August and part of September. Adults were swept from lucerne during every month of the year, but the numbers were low from November to February. Dissection of the ovaries during the winter showed that in January the eggs appear to be fully developed and ready for oviposition.

During 1935–37, average populations of *Lygus* were highest in the full-bloom stage of plant development, with the exception of the second crop in 1937, when the high population occurred in the bud and early blossom stage. The stages of new growth, maturing, mature and seed-crop stubble have on the average harboured relatively low populations.

L. hesperus was the main species present on lucerne producing seed. In the records for May and June, the period during which the first seed crop is usually grown, it constituted 93·18 and 88·15 per cent., respectively, of the total numbers captured. The average incubation period of eggs of *L. hesperus* in July and August 1935 was 8·44 days, and the average durations of development of the five nymphal instars when the average mean temperature was 85°F. were 2·69, 1·69, 1·74, 1·91 and 3·37 days, respectively. The eggs were always found in the younger, more tender growths of the terminal parts of the stems, and were most frequently situated in the flower buds and internodes of the stems.

The only natural enemies observed attacking the Capsids were Lygaeids of the genus *Geocoris*, *Nabis ferus*, L., *Formica perpilosa*, Wheeler, and two species of spiders, all of which attacked the nymphs. Little reduction in numbers following the activities of these predators has been observed.

Lack of uniformity in the time of cutting the lucerne appears to favour heavy infestation by *Lygus*, and if all the fields in a neighbourhood could be cut at approximately the same time, damage to the seed crop throughout the area would be materially lessened. In the Mohawk area, a uniform cutting programme was adopted in 1936 and 1937 [*cf.* also *R.A.E.*, A **29** 429], and few fields suffered heavy losses.

BEARD (R. L.). **The Biology of *Anasa tristis* DeGeer with particular Reference to the Tachinid Parasite, *Trichopoda pennipes* Fabr.**— *Bull. Conn. agric. Exp. Sta.* no. 440 pp. 595–680, 3 pls., 18 figs., 6½ pp. refs. New Haven, Conn., 1940.

A detailed account is given of laboratory and field investigations carried out during 1935–39 in Connecticut on the bionomics of the Coreid, *Anasa tristis*, DeG., which is a common pest of cucurbits in the western hemisphere, and of its Tachinid parasite, *Trichopoda pennipes*, F. [*cf. R.A.E.*, A **12** 213]. All stages of both insects are described, and their geographical distribution is briefly reviewed. *A. tristis* has only one generation a year in Connecticut, the adults hibernating singly or in small groups, often in crevices in buildings. Winter mortality is high. Pairing takes place in spring, and eggs are laid from early June until early September. The overwintered adults rapidly decrease in numbers during July, however, and have become very scarce by mid-August. The eggs are laid in batches on the lower surface of the leaves, and the total number deposited by individual females ranged up to 836 and averaged 241. It varied directly with longevity. Oviposition is retarded in cool, cloudy and rainy weather,

but is favoured by high temperatures and reaches a peak in early July. The egg stage lasted 17 days in June and 10 in late July, but was generally about 12 days. Mortality in this stage was low. The nymphal stage lasted 1–2 months, and field observations indicated that only about 10 per cent. of the nymphs give rise to adults. The latter seek hibernation quarters during September. Squash is the chief food-plant [*cf.* **23** 551], and summer squash is more severely attacked than winter (Hubbard) squash, probably because it is planted earlier and attracts the overwintered bugs. The injury caused is described. The author considers that although the cumulative effects of infestation may destroy squash plants, the injuriousness of the bug has in general been exaggerated.

Notes on natural enemies of *A. tristis* are given from the literature. *T. pennipes* is much the most important, and the only others observed in Connecticut were the Pentatomid, *Podisus maculiventris*, Say, *Nabis ferus*, L., larvae of *Chrysopa* sp., and a spider (*Misumenops asperatus*, Hentz), all of which were predacious on the nymphs but were not common enough to be of appreciable value. *T. pennipes* is a parasite of several Pentatomids and Coreids, and the adults feed on nectar of flowers ; lists are given of its hosts and the plants on which the adults have been taken, showing the authority for each record. It has three generations a year in Connecticut, though the third is not always complete, and it overwinters as a second-instar larva within the host. Pupation normally takes place in the soil at a depth of about an inch, and in cages oviposition sometimes occurred within two hours of emergence. Adult longevity averaged 6 days, with a maximum of 18. In the field, the egg stage usually lasted $3\frac{1}{2}$ days, but was prolonged to $5\frac{1}{2}$ days in cool weather. The larval stage is considered to average about 16 days, and the pupal stage lasts a month in the overwintering generation and 14–18 days in the first and second generations. The first adult parasites appeared in the field in the first half of June. The females oviposit on the bugs at random and lay an average total of rather over 100 eggs. In the field, 10–20 eggs were frequently found on a single bug, and occasionally as many as 48, but one of the resulting larvae destroys all the others, almost invariably before they complete the first instar. The behaviour of the larva after it has entered the host is described in detail. In addition to adult bugs, late-instar nymphs are also parasitised, and as many as 13 and 22 per cent. of those in the fourth and fifth instars, respectively, were observed in the field bearing eggs of *T. pennipes*. In such cases, however, the parasite larva remains in the first instar until the host becomes adult.

Special studies have shown that the presence of the larva in the host causes no loss of any function vital to the individual, but the injury caused as the larva leaves is so serious that the host usually dies within 24 hours. The effect of parasitism on reproduction is discussed in detail ; it has no functional significance in the male, but reduces the number of eggs deposited by the female [*cf.* **29** 120].

Although the rate of reproduction of *T. pennipes* is so high that it would, in theory, exterminate its host, this does not occur since the life-histories of the two insects do not synchronise sufficiently, the ability of the parasite to find hosts is not great and there is a considerable wastage through superparasitism. Estimates are made for the years 1937, 1938 and 1939 of the value of the parasite in reducing the numbers of *A. tristis*, and it is concluded that it is the chief factor

that maintains the population of the latter at a constant level of density. The experimental techniques used in the laboratory are described in an appendix.

HERIOT (A. D.). **A new Character distinguishing *Tetranychus pacificus* McGregor from *T. telarius* L.**—*Canad. Ent.* **73** no. 1 p. 1, 1 fig., 1 ref. Guelph, Ont., 1941.

The only reliable character available for distinguishing *Tetranychus pacificus*, McG., from *T. telarius*, L., has hitherto been the male aedeagus. Males occur only during the summer, whereas females are present throughout the year, and determinations are most likely to be required in spring and autumn. The author states, however, that the two mites can be distinguished in the adult female and deutonymphal stages by the pattern on the caudal half of the abdomen. The difference in striation is figured.

DUDLEY (H. C.), MILLER (J. W.), NEAL (P. A.) & SAYERS (R. R.). **Studies on Foodstuffs fumigated with Methyl Bromide.**—*Publ. Hlth Rep.* **55** no. 49 pp. 2251–2282, 4 figs., many refs. Washington, D.C., 1940.

A method of analysing foodstuffs to determine the total bromide residue after fumigation with methyl bromide is described. The amounts of methyl bromide (determined as bromide) absorbed during fumigation by fresh fruits and vegetables, cheese, cereals, nuts and dried fruit are shown in a table; they are several times greater than the normal bromide content, but there was generally a decrease after exposure to air. The content in milled grains, which have considerable adsorptive capacity owing to their great surface area, and foods such as cheese and nuts that contain fat or oil, in which methyl bromide is soluble, was greater than in other foodstuffs. A detailed account is given of investigations on the physiological and pathological changes produced in rats and rabbits by diets treated with methyl bromide. Food containing excessive amounts was lethal, but food that was fumigated with methyl bromide at the rate of 3 lb. per 1,000 cu. ft. for 24 hours had little or no deleterious effect, and it is concluded that the small amount of methyl bromide or bromide residues on commercially fumigated fresh fruits and vegetables and on dried fruits is unlikely to be harmful to the consumer. The risks associated with the actual process of fumigation with methyl bromide are discussed in an appendix, a list of recommended precautions is given and the symptoms caused in man by exposure to the gas are described. A classified and annotated bibliography occupying 5 pages is included.

[**Fruit and Vegetable Quarantine of Puerto Rico.**]—*U.S. Dep. Agric., B.E.P.Q.*, Q. 58, 5 pp. Washington, D.C., 1941.

In this revision of the quarantine and regulations restricting the movement of fruits and vegetables from Porto Rico into any other State, Territory or District of the United States with a view to preventing the spread of pests, including *Maruca testulalis*, Geyer, and fruit-flies of the genus *Anastrepha* [*R.A.E.*, A **13** 435; **21** 145], it is stated that these fruit-flies, hitherto known as *A. fraterculus*, Wied., comprise *A. suspensa*, Lw., *A. mombinpraeoptans*, Sein, and possibly

other species. The number of products authorised to enter the United States without certification is increased, and a revised list of them is given. The entry of okra [*Hibiscus esculentus*] is no longer permitted, since recent evidence indicates that the pink bollworm [*Platyedra gossypiella*, Saund.] has occurred in commercial shipments.

Edwards (W. H.). **Report of the Entomologist.**—*Rep. Dep. Sci. Agric. Jamaica 1st January 1939 to 31st March 1940* pp. 18–19. Kingston, 1940.

During the 15 months under review, localised outbreaks of *Chrysomphalus ficus*, Ashm. (*aonidum*, auct.) and *Tetranychus telarius*, L., occurred on banana in Jamaica. Work on the establishment and distribution of the predatory beetles, *Plaesius javanus*, Erichson, and *Dactylosternum hydrophiloides*, Macleay, against the banana weevil borer [*Cosmopolites sordidus*, Germ.] was continued with considerable success [*cf. R.A.E.*, A **28** 495]. A list is given of about 40 species of insect pests observed on other economic plants.

Hustache (A.). **Descripción de una especie nueva del género** *Conotrachelus* **Sch. (Col. Curculionidae).**—*Notas Mus. La Plata* **4** Zool. no. 23 pp. 323–328, 1 fig. Buenos Aires, 1939. (With a Summary in French.) [Recd. 1941.]

Descriptions are given of the adults of both sexes of *Conotrachelus denieri*, sp. n., taken in eastern Formosa, Argentina, in July 1939. In supplementary notes, P. C. L. Denier states that the weevils were taken on wild plants close to cultivated cotton. He has received examples from cotton in Concepción, Paraguay, where the larvae sometimes destroy the entire crop. The females oviposit in the green fruits ; the larvae feed in the bolls and have been observed to pupate in them, though it is considered that they normally do so in the soil. Bolls formed as early as October are attacked, and infested ones turn brown and fall.

De Santis (L.). **Sobre dos nuevos encírtidos hallados en la República Argentina con descripción de un nuevo género (Hymenoptera, Chalcidoidea).** [Two new Encyrtids found in Argentina, with a Description of a new Genus.]—*Notas Mus. La Plata* **4** Zool. no. 24 pp. 329–338, 8 figs. Buenos Aires, 1939. [Recd. 1941.]

Descriptions are given of the adults of both sexes of the Encyrtids, *Neoanisotylus bimaculatus*, gen. et sp. n., bred together with other parasites from the woolly apple aphis, *Eriosoma lanigerum*, Hsm., in Río Negro, Argentina, in 1937, and *Cheiloneurus longisetaceus*, sp. n., of which a female was taken on *Citrus* in 1937 and a male was bred from *Coccus hesperidum*, L., on *Citrus* in 1938, both in the Province of Buenos Aires.

Watanabe (C.). **On two Species of** *Aphidius* **bred from** *Cinara laricicolus* **(Matsumura). (Taxonomic Notes on Aphidiidae of Japan, II.)**—*Insecta matsum.* **15** no. 1–2 pp. 53–56, 1 fig., 3 refs. Sapporo, 1940.

Coclonotus (*Aphidius*) *pini*, Hal., and *C.* (*A.*) *laricis*, Hal., neither of which had previously been recorded from Japan, were bred from

Cinara laricicola, Mats., on larch (*Larix kaempferi*) in Hokkaido in 1937–40. The adults of both sexes of these parasites are described, a key to them is given and brief notes from the literature on their Aphid hosts and distribution are included.

Liu (C. L.). **Beginnings of a North China Pest Survey.**—*Peking nat. Hist. Bull.* **15** pt. 3 pp. 225–234, 1 ref. Peking, 1941.

An account is given of a survey of the insect pests of cultivated crops and trees started in North China in 1934 and continued until the outbreak of war with Japan. Many of the records obtained during the survey were destroyed, but the food-plants, injurious stage and distribution of each of 115 species, and the degree of injury it causes, are given in a table ; of these species, about 50 per cent. are Lepidoptera and about 20 per cent. Coleoptera. Brief notes are added on some of the outstanding pests, including a few undetermined species that do not appear in the table. The chief pests of cotton are *Aphis gossypii*, Glov., and *Sylepta derogata*, F. ; American cotton is more susceptible to the latter than native cottons. Other important pests include *Pyrausta nubilalis*, Hb., and *Diatraea* sp. on maize and *Sorghum* ; *Gryllotalpa unispina*, Sauss., and *G. africana*, P. de B., which attack many crops in the seedling stage ; the Agaristid, *Seudyra subflava*, Moore, and the Galerucid, *Oides decempunctata*, Billb., which feed on the leaves of grape-vines and are easily controlled by arsenical sprays ; the Zygaenid, *Illiberis pruni*, Dyar, which rolls and skeletonises the leaves of pear and flowering apple (*Pyrus spectabilis*) ; a variety of *Lymantria dispar*, L., that is apparently confined to apricot ; and *Malacosoma neustria*, L., which attacks apricot, peach and *P. spectabilis*.

Patel (J. S.). **Indian Central Jute Committee. Annual Report of the Agricultural Research Scheme for the Year 1939–40.**—50 pp., 6 pls. Calcutta, 1940.

One section of this report (pp. 36–41) deals with insect pests of jute (*Corchorus olitorius* and *C. capsularis*) in Bengal and consists chiefly of an account of the bionomics and control of *Apion corchori*, Mshl., the larvae of which develop in the stalks and damage the fibres. A single egg is laid in a hole gnawed by the female in the stem at the base of an apical petiole, and the larva, which hatches in 3–4 days, feeds within the stem for about 15 days before pupating there. The adult weevil emerges 5 days later, leaves the stem and mates within 3–4 days. The adults feed on the young leaves of jute. Oviposition and emergence were observed throughout the growing season, from May to September. There was no evidence of hibernation in the larval or pupal stage. Larvae were collected from stray jute plants as late as January, and adults were observed feeding on a weed, *Triumfetta rhomboidea*, after the jute crop was harvested, and were found overwintering in hedges and on several shrubs, but they did not appear to feed on them. The overwintered adults attack seedling jute in February and March. When oviposition punctures are made in seedlings, the top shoot sometimes dries up, so that the plant branches, and the length of the fibre is reduced ; in older plants, an accumulation of mucilaginous substance occurs round the tissue damaged by the larvae, binding the fibres together, and the fibre

breaks at this point during manufacture. The fibre may also be cut by the feeding larva, or marked by the egg puncture if the attack is light. After the end of August, the eggs are usually laid on the collar region of mature plants, in which case most of the larvae remain in the bark and do not damage the pith. As many as 33 punctures were observed in a single plant; in one field, about 28 per cent. of the plants were damaged six weeks after planting and 75 per cent. six weeks later. The larvae and occasionally the pupae were parasitised by two Hymenoptera, which killed 62 per cent. of 200 larvae and pupae collected from living plants.

Anomis (*Cosmophila*) *sabulifera*, Gn., appeared on jute in March 1939, was very numerous in June and July and disappeared by the time the crop flowered. Several eggs may be laid singly on the upper surface of the top leaves, and the larvae hatch in a few days and feed chiefly on the leaves. Pupation takes place about 16 days later in the soil or under dead leaves, and the adult emerges after 8 days. Spraying with lead arsenate gave satisfactory control in one locality, and nicotine sulphate was effective against the young larvae. *Diacrisia obliqua*, Wlk., did serious damage during June and July. The eggs are laid in clusters on the lower surface of the leaf, a single female laying a total of 400–1,000 eggs on three or four consecutive nights. The egg, larval and pupal stages last 6, 14–20 and 9 days, respectively, and oviposition begins 2 days after emergence. The larvae defoliate the plants and pupate in the soil. Hand-picking the clusters of young larvae gave effective control. Other pests included *Scopula emissaria*, Wlk., and *Prodenia litura*, F., which do not appear to have been recorded previously on jute, and *Laphygma exigua*, Hb., which defoliates the seedlings but does not appear to attack jute plants more than a foot high.

Cann (F. R.). **A Review of recent Work on the Prevention of** *Lyctus* **Attack by Chemical Methods.**—*For. Abstr.* **2** no. 3 pp. 177–179, 5 refs. Oxford, 1941.

Species of *Lyctus* caused serious losses of timber in Great Britain after the war of 1914–18, and since present war-time conditions are likely to lead to the accumulation of stocks of hardwood in which the beetles can feed and breed undisturbed and which, when distributed, will cause extensive spread of infestation, the author reviews work in Britain [*R.A.E.*, A **29** 146], Australia [**24** 373; **27** 509] and the United States on the use of wood preservatives for preventing infestation. In the United States, where *Lyctus* is a serious pest in hardwood timber for home use and for export, investigations concerned primarily with the treatment of freshly-cut green timber subsequently exposed to attack by *Lyctus parallelipipedus*, Melsh., and *L. planicollis*, Lec., were undertaken by the Bureau of Entomology and Plant Quarantine in collaboration with the National Hardwood Lumber Association and manufacturing chemists, and the results published by M. B. Christian in the *Southern Lumberman* on 15th December 1939 and 15th June 1940. The results recorded in the first paper indicated that immersion for 10 seconds in a 5 per cent. aqueous solution of borax at 130°F. protects green oak from *L. parallelipipedus* but not from *L. planicollis*, and that borax, which also prevents sap stain, is the cheapest and most practical substance for use on a commercial scale. *L. parallelipipedus* is smaller than *L. planicollis* (and also than

L. brunneus, Steph., and *L. linearis*, Goeze, the commonest species in Britain), and its eggs may therefore be deposited nearer the surface of the sapwood, which is believed to account for the success of certain treatments against it. When penetration was increased by raising the temperature of the borax solution, the most satisfactory results against *L. planicollis* were obtained at a temperature of not less than 180°F., but this treatment did not always prevent infestation. In the second paper it was stated that 1 and 2 per cent. aqueous solutions of Sulfocide (sodium pentasulphide in liquid form) or other finely divided sulphur materials were effective in laboratory tests in which the wood was immersed for 10 seconds at 190°F., but further work is necessary before these substances can be recommended for use on a commercial scale. In tests with preservatives of the solvent type for the protection of seasoned timber, the best results were given by a 3 per cent. solution of pentachlorphenol in a light fuel oil in the kerosene range, a minimum immersion period of 3 minutes being recommended. Certain precautions must be observed in handling pentachlorphenol, since it is slightly toxic to man and continued exposure to the oil solution may cause skin irritation.

The most satisfactory method of protecting green timber from attack by *Lyctus* would undoubtedly be an effective immersion treatment applied immediately after sawing; such a treatment would afford protection until untreated surfaces were exposed when the wood was dressed or re-sawn for manufacture, and by this time the greatest risk of infestation is past. The results obtained in the United States are promising, but they require confirmation before they can be generally accepted. The problem of treating seasoned or partly seasoned wood still remains, and no chemical treatment other than the use of water-soluble salts applied by impregnation processes can be recommended in Britain until the effectiveness and cost of application of solvent-type preservatives have been tested on a commercial scale. The control measures at present available, therefore, comprise regular inspection of susceptible hardwoods, the segregation of infested material, and the heat-sterilisation or removal and destruction of infested sapwood.

Wilson (G. F.). **Some Delphinium Pests.**—*Delphinium Yearb.* 1941 pp. 7–9. 1941.

A list is given of slugs and Arthropods collected in England between November and March from dead stalks of *Delphinium* remaining in the soil after cutting. In addition to insects that are not injurious to *Delphinium*, they include cutworms, *Hepialus lupulinus*, L., and *Plusia moneta*, F. Larvae of *Hepialus* often cause extensive damage to the rootstocks, to which they migrate from weedy grasslands and headlands. Those of *P. moneta* occur on the buds, leaves, flowers and seed-vessels of *Delphinium* and monkshood (*Aconitum*) during late April, May and June, oviposition taking place during June and early July among the flower buds or on the petals. The larvae overwinter in the hollow stems both above and below ground and ascend the shoots in spring. If infestation is severe, the larvae of *H. lupulinus* can be controlled by incorporating flake or whizzed naphthalene with the soil and those of *P. moneta* by lightly spraying with lead arsenate or dusting with nicotine. The stems of all herbaceous plants, particularly those with hollow stalks, should be cut as low as possible in autumn, so that no shelter is provided for hibernating pests.

FIEDLER (H. . **Die wichtigsten schädlichen Erdraupen der Gattung *Agrotis* Hb. (Lep., Noct.). Ein Beitrag zur Biologie, Morphologie und praktischen systematischen Erkennbarkeit der Larven und Imagines von *Agrotis segetum* Schiff., *A. exclamationis* L., *A. vestigialis* Rott. und *A. tritici* L.** [The most important injurious Cutworms of the Genus *Agrotis*. A Contribution to the Biology, Morphology and practical Identification of the Larvae and Adults of *A. segetum*, *A. exclamationis*, *A. vestigialis* and *Euxoa tritici*.]—*Dtsch. ent. Z.* 1936 pt. 3–4 pp. 113–179, 1 pl., 45 figs., 3 pp. refs. Berlin, 1937. [Recd. 1941.]

A detailed account is given of observations carried out in 1934–36 in the region of Berlin on the life-history and morphology of *Agrotis segetum*, Schiff., *A. exclamationis*, L., *A. vestigialis*, Rott., and *Euxoa* (*A.*) *tritici*, L., the larvae of which are serious pests of crops in fields and market gardens. The larvae and adults of these Noctuids are described in detail, with special reference to the internal anatomy of the larvae, characters distinguishing the larvae are discussed and a key to them is given.

The duration of the egg stage of *A. segetum* ranged from 12 days at an average temperature of 18°C. [64·4°F.] to 3 at 30·5°C. [86·9°F.], but there was considerable mortality at temperatures of about 26°C. [78·8°F.] and above. It was calculated that the threshold of development lies at 14·6°C. [about 58·3°F.]. The larval stage averaged 68 days at room temperature (averaging 25·2°C. [about 77·4°F.]), and there are five or six larval instars, the last of which is completed in about 40 days, including a prepupal stage of about 14 days. The larvae, which usually hatch at night, begin to be negatively phototactic during the second instar. Larvae in the third and subsequent instars were never found by day on the plants, but only under fallen leaves or just below the surface of the soil. Young larvae feed on the leaves of the plants, mostly weeds, on which the eggs are laid, and reject only those that are very hairy or have a hard epidermis. The older larvae also eat food rich in chlorophyll, but as they cannot climb the stems they attack the parts of the plant that are immediately above the ground. Larvae of *A. segetum* occur both in rich garden soil and in sandy soil and attack a large number of cultivated plants, with a preference for potato. A list of food-plants based on the literature and original observations is given. Larvae of *A. exclamationis* frequently occur together with those of *A. segetum*, but those of *A. vestigialis* avoid rich soil and prefer dry, warm drift sand, being particularly common under couch grass, *Agropyrum* (*Triticum*) *repens*. The larvae of *Euxoa tritici* occur in both sand and clay soils, and therefore, like *A. segetum*, attack a large number of cultivated plants, but show a preference for cereals. Larvae of all four species are rare in irrigated fields near Berlin, where no outbreaks of *A. segetum*, *A. exclamationis* or *A. vestigialis* have occurred for the last 30 years and there has been no attack on rye or other cereals.

All four species pupate in the soil in earthen cells constructed at the beginning of the pre-pupal period. Near Berlin, they have one generation a year, but a very few individuals of *A. segetum* and *A. exclamationis* give rise to a second generation, which does not survive the winter. Adults of *A. segetum* and *A. exclamationis* are present from mid-May to the end of June and oviposit mainly in the first half of June. The eggs are laid, up to a height of 8 ins. above ground, in

batches of 600–700 on the stems and lower surfaces of the leaves of low-growing wild plants. The larvae hatch in 8–14 days, feed until the end of September and then hibernate in tunnels in the soil. Pupation occurs in spring, with no resumption of feeding. By mid-May the pupa has worked its way out of the cell and moved to just below the surface of the ground. Adults of *A. vestigialis* occur in August and early September. The larvae hatch in September, feed on tender roots and overwinter. They resume feeding in spring, and become fully fed by mid-April if food is abundant or at the end of May if it is not. Towards the end of May they burrow to a depth of 4–8 ins., rest for 6–8 weeks and then pupate. The pupal stage lasts 2–3 weeks. The adults of *Euxoa tritici* occur in July. The eggs apparently require frost in order to develop, and if the weather is mild they do not hatch until the end of December. The larvae feed on weeds and winter crops beneath the snow cover, and later enter the soil, where they cause serious injury to the roots. Growth is slow until warm weather sets in. The larvae feed until early June and then pupate at a depth of 4–6 ins.

Injury to plants in gardens and greenhouses, where the soil is unusually rich, is due chiefly to *A. segetum* and *A. exclamationis*, and therefore occurs mainly from mid-July to the end of September. Lettuce and cabbages are the most severely injured, though almost all plants may be attacked. The injury to lettuce and to ornamental plants in pots and greenhouses is described. Control of the larvae in the ground is difficult. Kainit should be hoed into the soil in fields, but in gardens the removal of all infested plants is the best measure. All weeds should be eradicated, and soil for use in pots, frames and greenhouses sieved.

STANLEY (J.). **A mathematical Theory of the Growth of Populations of the Flour Beetle *Tribolium confusum* Duv. IV. A modified Theory descriptive of the Relation between the limiting Value of Egg-populations in the Absence of Hatching, and the Volume (or Weight) of Flour used in the Culture.**—*Ecology* **22** no. 1 pp. 23–37, 5 figs., 4 refs. Brooklyn, N.Y., 1941.

The following is the author's summary: With reference to populations of the flour beetle, *Tribolium confusum*, Duv., a mathematical theory descriptive of the growth and limiting values of egg-populations in various volumes of flour (where the eggs are prevented from hatching) is discussed. A special flour containing 3 per cent. of ground wheat germ, nutritionally satisfactory for the growth of populations of *Tribolium* under crowded conditions [*cf. R.A.E.*, A **27** 175], where many eggs are eaten, is discussed. Experiments in various volumes of flour, where the eggs are prevented from hatching by periodic substitution of new eggs, are described. In these experiments the eggs accumulate, and the egg-populations in time attain to the asymptotic values at which eggs are found and eaten by the adults present as rapidly as they are laid. Referring to previous publications, discrepancies between the original theory [*cf.* **21** 144; **23** 104] and experimental data are pointed out, it being shown that the older theory is not adequate for such crowded populations. A modified theory is developed on the basis of the time spent in contact with eggs and flour respectively, per unit time, by the adults present, rather than on a basis of the number of eggs, and weight of flour encountered per unit time. By actual test against experimental data, it is shown

that this modified theory is in good agreement with experimental data. Methods of fitting particular equations to the growth of egg-populations in flour masses of various volumes are described, and a general equation predicting the number of eggs to be expected in a flour mass of given volume at a given time is derived. In particular it is shown, both by theory and experiment, that when beetles are introduced into flour, and the eggs are prevented from hatching, they accumulate with ever decreasing rapidity, until finally they reach the asymptotic value at which they are found and eaten as rapidly as laid. These limiting values are linear functions of the weight (or volume) of the flour, all volumes of flour with limit egg-populations containing the same number of eggs (about 32) per gram of flour, which in the flour used amounts to about 16 per cubic centimeter. If eggs are added artificially to force the population above this value, the eggs will be eaten at a constant rate equal to the maximum possible rate of consumption, down to a certain value, and thereafter will be eaten more and more slowly as the egg-population decreases to approach the asymptote from above, at which value the rate of consumption will again equal the rate of production.

Caspari (E.). **The Influence of low Temperature on the Pupation of *Ephestia kühniella* Zeller.**—*J. exp. Zool.* **86** no. 3 pp. 321–331, 1 fig., 13 refs. Philadelphia, Pa., 1941.

The following is substantially the author's summary. Old prepupae, a high percentage of younger prepupae and a few old larvae of *Ephestia kuehniella*, Zell., can pupate at 6–9°C. [42·8–48·2°F.]. The young prepupae and old larvae that are unable to pupate at this low temperature develop into " permanent larvae," living considerably longer than their pupating age-mates, without pupating. Larvae kept for 2–8 months in this temperature are able to pupate if returned to room temperature. If, however, their heads, the source of the pupation hormone, are tied off, they become " permanent larvae," surviving as long as 2–3 months in the larval state. It is concluded that the formation of the pupation hormone is inhibited by exposure to low temperatures, and there is some indication that the tissues can perhaps react to a hormone stimulus at low temperature.

Crombie (A. C.). **On Oviposition, olfactory Conditioning and Host Selection in *Rhizopertha dominica* Fab. (Insecta, Coleoptera).**—*J. exp. Biol.* **18** no. 1 pp. 62–79, 1 graph, 40 refs. London, 1941.

The following is substantially the author's summary of laboratory investigations on the senses used in food-finding and the factors inducing oviposition in *Rhizopertha dominica*, F., which infests stored grain. The sense of smell appeared to be the most important in directing the beetles to an environment where food was present. Responses were obtained in an olfactometer with maize, wheat, oats, barley and extracts of wheat and maize. The use of the sense of sight was also investigated. Black celluloid capsules used in experiments were more attractive to the adults than transparent ones, as they were more readily seen. Once within an environment having

the odour of food, the sense of touch appeared to be paramount in the selection of the oviposition site. The influence of size, shape and texture was investigated ; but in the absence of appropriate patterns of stimuli involving both olfactory and tactile sensations, restraint from oviposition was exercised. No predilection was shown by the beetles for oviposition or feeding in the food in which they had been reared as larvae. Neither did the larvae especially choose for entry substances in which their parents had been reared. The adults could be made tolerant to the odour of peppermint instead of being repelled by it in an olfactometer by exposing them to it for a few weeks. The effect wore off after 10–14 days' isolation from peppermint in wheat. Olfactory receptors, which appear to be located on the antennae and legs, were used in both food-finding and recognition of the opposite sex. A list is given of the substances in which the beetles were reared, and the bearing of the results on the problem of " gestalt " in conditioning and on changes of habit in insects of economic importance is briefly discussed.

[Saakyan (A.).] **Саакян (А.). Influence of Temperature and Carbon Dioxide on the Respiration Intensity of** *Tribolium confusum* **Duv.** [*In Russian.*]—*Acta Univ. Asiae med.* (8, Zool.) fasc. 38, 15 pp., 5 refs. Tashkent, 1938. (With a Summary in English.) [Recd. 1941.]

The author summarises the results of work by Hazelhoff [*R.A.E.*, A **17** 80] and Cotton [**20** 696] on the effect of increased concentrations of carbon dioxide on respiration in insects and gives a detailed account of laboratory investigations on the effect on the respiration of last-instar larvae, pupae and adults of *Tribolium confusum*, Duv., of temperature and various concentrations of carbon dioxide. The technique of the experiments is described. They showed that at 22°C. [71·6°F.] and a relative humidity of 69 per cent., the coefficient of respiration of adults of *T. confusum* (the ratio of the carbon dioxide exhaled to the oxygen consumed) was 0·93. The intensity of respiration (expressed as the weight of CO_2 in mg. exhaled by an individual in an hour) under laboratory conditions (a mean temperature of 16°C. [60·8°F.] and a mean relative humidity of 62 per cent.) was 0·086, 0·02 and 0·129 for larvae, pupae and adults, respectively. When the insects were kept for a day at higher temperatures, these figures rose to 0·16, 0·073 and 0·172 at 23°C. [73·4°F.], 0·22, 0·133 and 0·23 at 30°C. [86°F.] and 0·24, 0·143 and 0·246 at 40°C. [104°F.], respectively. The increases caused by keeping the insects at high temperatures for one hour were insignificant ; they were only slightly greater after exposure for three days than after one.

At a mean temperature of 17°C. [62·6°F.], the intensity of respiration of the adults was not affected by an atmosphere containing not more than 0·5 per cent. carbon dioxide, but increased if this percentage was raised to 1–3. The increase was still more marked if the temperature was raised, and was greatest when the percentage was 2 and the temperature 40°C. At a concentration of 5 per cent. carbon dioxide, the intensity of respiration decreased sharply.

It is concluded from these experiments that it would be possible to decrease the dosages of expensive fumigants by adding carbon dioxide to them and fumigating at a suitable temperature.

[Solodovnikova (O.).] **Солодовникова (О.). Biology of the Dermestidae** *Attagenus byturoides* **Sols. and** *Trogoderma versicolor* **Creutz. and Control of them.** [*In Russian.*]—*Acta Univ. Asiae med.* (8, Zool.) fasc. 41, 20 pp., 3 figs. Tashkent, 1938. (With a Summary in English.) [Recd. 1941.]

Infestation by Dermestids in flour mills and storehouses in Central Asia has greatly increased of recent years, and a survey was carried out in 1932 on their distribution and the extent of the damage caused. The principal species found were *Attagenus byturoides*, Solsky, and *Trogoderma versicolor*, Creutz., which usually occurred together. All stages of both species are described, and characters distinguishing the larvae, pupae and adults are given. Observations in the laboratory and in warehouses and mills showed that the two species have similar life-histories. Both have one generation a year and hibernate in the larval stage. The durations of the individual stages are practically identical, the eggs hatching in 8–14 days, the larval stage lasting about 11 months and the pupal stage 7–15 days for *T. versicolor* and 6–8 for *A. byturoides*. The adults survive for up to a fortnight but do not feed. The larvae attack flour, bran, wheat, maize, rice, leather and dead insects; those of *T. versicolor* also attack sunflower seeds, rusks and wool and, in the later instars, do serious damage to cocoons of the silkworm [*Bombyx mori*, L.] by feeding on the pupae within them. In stored seeds, the germ is attacked first and frequently the whole seed is hollowed out, the husk alone being left; infested flour acquires a slightly bitter taste and an unpleasant smell and is apt to form lumps.

T. versicolor oviposits during June in cracks in floors and beams. Hatching begins in mid-June and continues until July, so that larvae of different instars occur together. They avoid light and are difficult to detect, as they hide in cracks, packing materials and stored products. They are most active at a temperature of 25–30°C. [77–86°F.]. In experiments, larvae deprived of food withstood a temperature of −12·5°C. [9·5°F.] and when fed they survived temperatures as low as −19°C. [−2·2°F.]. The periods for which larvae survived starvation ranged from a fortnight in the first instar to 4 months in the sixth and seventh, so that temporary clearing of the warehouses will not eliminate infestation. Pupation takes place between mid-May and mid-June at 24–28°C. [75·2–82·4°F.] and occurs at the site of larval feeding. Most of the adults emerge at the end of May or beginning of June. Pairing was observed between 10th and 25th June, and the oviposition period, which began 5–6 days later, lasted 3–4 days. Females laid up to 30 eggs in the laboratory, but this number is probably exceeded under natural conditions. A few of the larvae complete their development in August but the resulting adults do not oviposit.

Larvae of *A. byturoides* are able to feed on uninjured seeds from the second instar, whereas those of *T. versicolor* cannot do so before the fourth. They are also more resistant to adverse conditions, since larvae kept with or without food at temperatures as low as −19°C. survived for a month, and sixth- and seventh-instar larvae survived without food for up to 6 months at normal temperature. Pupation occurs in May and the adults emerge in June. Females deposit up to 90 eggs, in cracks containing débris from stored products.

The adults of both Dermestids fly actively; infestation is spread by this means and by the transport of larvae in packing materials

and on clothing. The control measures recommended include cleanliness in warehouses, good ventilation, light, screening windows and fumigation. In experiments, complete mortality of the larvae and pupae of both species was given by a spray containing 5 per cent. of an emulsion consisting of 45 parts of Petrov's Contact [*cf. R.A.E.*, A **20** 200], 5 parts of water and 50 parts of a mixture of carbon bisulphide and kerosene; it also killed nearly 50 per cent. of the adults in 10 days. Complete mortality of the larvae was given by fumigation for 24 hours at 20°C. [68°F.] with chloropicrin (2 oz. per 100 cu. ft.), carbon bisulphide (1 oz. per 10 cu. ft.) or chlorine (1 oz. per 40 cu. ft.). Dusting with magnesium carbonate had no effect. All the larvae were killed by exposure to 50–51°C. [122–123·8°F.] for 5 hours, 60°C. [140°F.] for 15 minutes or 80°C. [176°F.] for 1–2 minutes. Since the germinating power of grain subjected to temperatures of 65°C. [149°F.] or 80°C. is impaired only after exposures of 5 hours and 10 minutes, respectively, it would be possible to control the Dermestids by means of heat without affecting the grain.

[Khabirova (M.).] **Хабирова (М.). Some Data concerning the Bioecology of *Sitophilus granarius* L.** [*In Russian.*]—*Acta Univ. Asiae med.* (8, Zool.) fasc. 43, 14 pp., 5 refs. Tashkent, 1938. (With a Summary in English.) [Recd. 1941.]

An account is given of laboratory investigations in Tashkent on the effect of temperature and humidity on the duration of development and the mortality of *Calandra* (*Sitophilus*) *granaria*, L., for which purpose pairs of adult weevils were kept at 20°C. [68°F.] and 75 per cent. relative humidity, and at 25 and 30°C. [77 and 86°F.] combined with relative humidities of 34, 44, 75 and 93 per cent. At the lowest temperature the weevils were fed on various grains, but at the others they were given pearl barley, which is a very favourable medium. The results are shown in tables. Optimum conditions occurred at 25°C. and a relative humidity of 93 per cent., when the longevity of the parent weevils was greatest (averaging 94·6 days), the period elapsing between the beginning of the experiments and the appearance of the new adults was least (averaging 35 days), and the percentage of the progeny that reached the adult stage highest (averaging 98). The corresponding figures were 92·5, 49 and 80 at 75 per cent. humidity, 69·8, 52 and 52 at 44 per cent. and 51·2, 69 and 10 at 34 per cent. When the temperature was increased to 30°C., adult longevity was decreased at all humidities. No progeny developed at the two lower humidities, and fewer reached the adult stage at the higher ones. Conditions were somewhat more favourable at 20°C. and 75 per cent. relative humidity than at 30°C. At all the temperatures tested, adult longevity varied directly with the relative humidity.

Observations on the fluctuations in abundance of the weevil under natural conditions, carried out in 1934–35 in a flour mill and a pearl-barley factory near Tashkent, confirmed the laboratory observations as to the thermal optimum. Practically all the adults died in October–December, when the temperature did not exceed 10°C. [50°F.] and the few survivors became inactive. Activity was resumed in February–March, as the temperature rose above 10°C., and reproduction began. The weevils were most abundant in May–August at 22–30°C. [71·6–86°F.]. It appears, therefore, that under the climatic conditions of Central Asia, *C. granaria* is active during 9 months in the year.

In feeding tests with various cereals, of which the percentage moisture content was 10–11, pearl barley was the most readily attacked by the adults, followed, in order of decreasing attractiveness, by wheat, rice, maize and barley. Observations at 20°C. and 75 per cent. relative humidity showed that pearl barley was the most favourable diet, the longevity of the adults averaging 85·2 days, the life-cycle of the progeny 71·7 days and the percentage of the progeny reaching the adult stage 50·3; the corresponding figures were 81·1, 77·2 and 31·2 for wheat and 89·7, 76·5 and 17 for rice. Adults that fed on ground rice lived for an average of 105·3 days but did not oviposit. In tests with wheat kept at 14–15°C. [57·2–59°F.], 66·2 per cent. of the weevils were attracted to grain containing 18 per cent. humidity, 25·1 per cent. to normal wheat containing 9·1 per cent. humidity, and only 8·7 per cent. to wheat that had been specially dried for 1½ hours at 50°C. [122°F.].

[Khalilova (R.).] **Халилова (Р.). On the Conditions resulting from poisoning** *Tribolium confusum* **Duv.** [*In Russian.*]—*Acta Univ. Asiae med.* (8, Zool.) fasc. 44, 14 pp., 5 refs. Tashkent, 1938. (With a Summary in English.) [Recd. 1941.]

The experiments described were carried out to determine the effect of sublethal dosages of hydrocyanic acid gas on the fecundity of *Tribolium confusum*, Duv., and the viability of the progeny of fumigated individuals, at a temperature of 27°C. [80·6°F.] and a relative humidity of 75 per cent. Newly emerged males and females were placed separately in tumblers in a container, into which hydrocyanic acid gas was released by means of dilute sulphuric acid from potassium cyanide used at rates of 1 oz. per 400 and 800 cu. ft. After fumigation, the beetles were transferred in batches of 10 pairs to jars containing wheat flour, and counts of larvae, pupae and adults were made at intervals of 5–10 days. The results, which are given in a series of tables, showed that fumigation at the higher dosage either reduced fecundity or decreased the viability of the progeny, as the average number of live progeny (larvae, pupae and adults) per female was only 15·4 after 65 days, as compared with 27·9 in the controls, and the development of all stages was retarded. Fumigation at the lower rate had a stimulating effect, as the average number of progeny per female was 47·6 after 65 days, as compared with 25·5 in the controls, and development was accelerated.

From these observations, it is concluded that when granaries or storehouses are fumigated, it is essential to obtain complete mortality of the pests, either by increasing the dosage of the fumigant or by repeated treatment. Care should be taken to increase the effectiveness of fumigation by maintaining proper temperature and securing air-tight conditions in the building, since insects that survive treatment may not only still be able to reproduce normally, but their fecundity may even be increased.

[Telenga (N. A.).] **Теленга (М. А.). Biological Method of controlling the Weevil.** [*In Ukrainian.*]—*Visti Akad. Nauk ukr. rad. sotz. Resp.* 1940 no. 7–8 pp. 63–69, 2 figs. Kiev, 1940.

The author considers that outbreaks of the beet weevil [*Cleonus punctiventris*, Germ.] in the Ukraine are largely due to agricultural

practices that decrease the effectiveness of the Pteromalid, *Xenocrepis* (*Caenocrepis*) *bothynoderis*, Grom., which parasitises the eggs of the weevil and is widely distributed in the Ukraine. Investigations in 1940 indicated that *C. punctiventris* is its only host and showed that it can complete 5–6 generations a year in the district of Kiev, the life-cycle in summer lasting 13–16 days. The females uncover the eggs of the weevil in the soil, oviposit in them, and sometimes cover them up again. Eggs placed on the surface of the soil were usually ignored. Mass parasitism occurs when the temperature reaches 23–24°C. [72·4–75·2°F.] in the shade and 27–28°C. [80·6–82·4°F.] on the surface of the soil in the sun. The larvae hibernate in the host eggs in the upper layer of the soil, and the adults normally emerge in the second half of May, when the weevils begin to oviposit. If, however, deep ploughing has buried the host eggs to a depth of 8–9 ins., the adults do not emerge until mid-June. It was also observed that they emerged earlier in fields in which it was intended to sow millet after beet than in those in which beet had been followed by barley or oats, which was probably because the soil was cooler when protected from the sun by the growing crops. The adults fly to new plantings of beet and can cover a distance of 1½ miles. Other conditions being equal, the number of parasites in new beet fields varied inversely with their distance from those of the previous year.

Counts of the larvae and pupae of the weevil in four plots of beet, and of the larvae and adults of the parasite in three of them, showed that the infestation by the weevil was lowest in a plot in which beet had been sown for the second year in succession; the author believes this to have been due to the presence of the parasites during the period of the mass oviposition of the weevil. Of the other three plots (in all of which beet was sown for the first time), the one furthest from beet fields of the previous year was the most heavily infested and harboured the smallest number of parasites, but infestation was greater and the parasite less numerous in a plot close to a former beet field then under barley than they were in a plot about 600 yards from a field of millet that had previously been under beet. This indicates that the time of emergence of the parasites is more important than the actual distance of the new planting from old ones. It appears that the adult parasites do not disperse over a large area when migrating from an old beet field, but alight as soon as they find a new one.

It is considered from these investigations that the value of deep ploughing after the beet has been harvested should be reconsidered, since this practice retards the emergence of the parasite until the chief oviposition period of the weevil is over and reduces the number of generations produced in the year to 3–4, of which only 1–2 are complete. It is also advisable to sow late summer crops such as millet or buckwheat in former beet fields that are close to new plantings.

Sardiña (J. R.). **Acerca de la "blanqueta" del pimiento (nota preventiva).** [Regarding the "Blanqueta" of Peppers (Preliminary Note).]—*Bol. Pat. veg. Ent. agríc.* **9** pp. 1–8, 7 figs.; also as *Trab. (Ser. Fitopat.) Inst. nac. Invest. agron.* no. 20. Madrid, 1940.

A description is given of a disease, presumably due to a virus, that affects the leaves and fruits of peppers [*Capsicum*] in Spain. The most marked symptom is the appearance on the smaller leaves of

patches of dark green intermingled with others of colour varying from light green to yellow, together with a crinkling of the leaf surface. In experiments, the disease was transmitted by *Myzus* (*Myzodes*) *persicae*, Sulz., and by sap inoculation. With the Aphid, the incubation period was about 20 days, and with sap inoculation, about a month.

Gómez Clemente (F.). **Ensayos de multiplicación de algunos insectos útiles importados, en especial de** *Trichogramma minutum* **Riley, parásito de la** *Cydia* (*Carpocapsa*) *pomonella* **L.** [Attempts to multiply some imported beneficial insects, especially *T. minutum*, a Parasite of *C. pomonella*.]—*Bol. Pat. veg. Ent. agríc.* **9** pp. 21–39, 14 figs., 12 refs.; also as *Trab.* (*Ser. Fitopat.*) *Inst. nac. Invest. agron.* no. 32. Madrid, 1940.

Work done up to 1934 on the biological control of *Ceratitis capitata*, Wied., in Spain is briefly reviewed [*cf. R.A.E.*, A **22** 607]. In March 1936, the Encyrtid, *Comperiella bifasciata*, How., was imported from California in the hope that it would parasitise *Chrysomphalus dictyospermi*, Morg., but it did not attack this Coccid or two others, *Lepidosaphes* (*Mytilococcus*) *gloveri*, Pack., and *Aspidiotus hederae*, Vall. Consignments of *Trichogramma minutum*, Riley, and of adults of *Ascogaster quadridentata*, Wesm. (*carpocapsae*, Vier.) were received in Valencia from the United States in August 1935 and June 1936, respectively, both for use against *Cydia pomonella*, L. *T. minutum* was reared in the laboratory on eggs of *Sitotroga cerealella*, Ol., and both parasites were liberated in apple orchards infested by *C. pomonella* in 1936, but the results of the liberations could not be ascertained, as all the work was terminated by the outbreak of the civil war. Information on the biology of *T. minutum* is given from the literature, together with an account of the technique of laboratory breeding in Spain and of observations made in the course of it.

Benlloch (M.). **La fumigación cianhídrica en los grandes depósitos de trigo infestados por el gorgojo** (*Calandra granaria* **L.).** [Hydrocyanic Acid Gas Fumigation in large Stores of Wheat infested by *C. granaria*.]—*Bol. Pat. veg. Ent. agríc.* **9** pp. 40–50; also as *Trab.* (*Ser. Fitopat.*) *Inst. nac. Invest. agron.* no. 22. Madrid, 1940.

Although hydrocyanic acid gas has a low penetrative power, it is used commercially in Spain for the fumigation of heaps of stored grain. Two methods are in practice. In the first, the gas is introduced into the heap by means of tubes placed at various depths and having holes at the ends. In the second, it is introduced through one or two tubes which have flexible connections and are manipulated by an operator wearing a gas mask, so that it can be applied uniformly over the whole surface of the mass and at different depths. The author tested the effectiveness of these methods for the control of *Calandra granaria*, L., in stored wheat and gives a detailed account of the results. The gas was liberated from a proprietary preparation at rates equivalent to about 57 oz. HCN per 1,000 cu. ft. by the first method and 16·6 oz. by the second, and the periods of exposure were 58½ and 72 hours, respectively. Batches of weevils in flasks were placed at various depths in the heaps and in the free space. In both tests, the distribution of the gas in the heaps was unsatisfactory and concentrations sufficient to give appreciable mortalities of the weevils were obtained

only in the immediate vicinity of the points of application. The second method gave better results and might have been satisfactory if the dosage had been doubled.

Gómez Clemente (F.). **El "barrenador" del arroz.** [The Rice Borer.]—*Bol. Pat. veg. Ent. agríc.* **9** pp. 51–66, 13 figs., 10 refs.; also as *Trab.* (*Ser. Fitopat.*) *Inst. nac. Invest. agron.* no. 28. Madrid, 1940.

In recent years, rice in Valencia has been attacked by a Pyralid, all stages of which are described and which is almost certainly *Chilo simplex*, Btlr. It apparently has two generations a year; it was first observed in 1933, caused serious injury in 1935 and has appeared in each succeeding year, though it was somewhat less numerous in 1939. Young larvae were observed in a rice-field in August; they had probably hatched from eggs deposited by moths that emerged 10–15 days previously, since they had not yet bored into the stems. Later observations showed that as the straw dries, the larvae move to the base of the plant, where they hibernate. Hibernating larvae kept at 26°C. [78·8°F.] and 80 per cent. relative humidity pupated in 30–60 days and gave rise to adults 10–12 days later. The control measures employed in the United States and Japan are summarised, and their application in Spain is discussed. Egg-collection is expensive, and the best measure is the eradication of all plants showing signs of infestation. Burning the straw is beneficial, but many larvae survive in the stubble, which should also be burnt. In one rice-growing district, the stubble remains under water for four months, and this reduces the infestation considerably. In 1935, tests to ascertain the best insecticide for adding to the water in the fields were made on infested rice stubble placed in water about two inches deep in a series of shallow concrete compartments. After 48 hours, the compartments were drained and a count was made of the living and dead larvae. The results are tabulated. Gas oil and kerosene, each at the rate of 3 fl. oz. per sq. yd., gave mortalities of 96·8 and 90 per cent., respectively, but they are expensive and their possible effect on the soil is not known. The other substances tested gave very inferior results.

del Cañizo (J.). **Los tratamientos del viñedo (datos prácticos).** [Practical Data on Measures against Pests and Diseases in Vineyards.]—*Bol. Pat. veg. Ent. agríc.* **9** pp. 67–71, 1 ref.; also as *Trab.* (*Ser. Fitopat.*) *Inst. nac. Invest. agron.* no. 30. Madrid, 1940.

Data are given on the treatments that are applied in various parts of Spain against insect and fungous pests of grape vines. Those used against insects are Bordeaux mixture against *Haltica ampelophaga*, Guér., and arsenical sprays against *Sparganothis pilleriana*, Schiff., and *Polychrosis botrana*, Schiff.

Cánovas (C.). **La lucha biológica contra** *Ceratitis capitata* **Wied., y orientaciones para su aplicación en España.** [Biological Control of *C. capitata* and Data for its Use in Spain.]—*Bol. Pat. veg. Ent. agríc.* **9** pp. 72 106, 9 figs., 2 graphs, 3 pp. refs.; also as *Trab.* (*Ser. Fitopat.*) *Inst. nac. Invest. agron.* no. 33. Madrid, 1940.

An account is given from the literature of work on the biological control of *Ceratitis capitata*, Wied., in Hawaii and other parts of the

world, together with a list of its recorded parasites, showing their distribution and including notes on the biology and other hosts of some of them. Two Braconids have been introduced into Spain against it [*cf. R.A.E.*, A **22** 607], but neither proved successful. A list is given of nine species that the author considers suitable for introduction, of which *Tetrastichus giffardianus*, Silv., and *Opius humilis*, Silv., are the most promising. Since the climate of the Canary Islands is similar to that of Hawaii, it is suggested that the parasites should be introduced there and studied in an insectary before being imported into Spain. *C. capitata* develops throughout the year in the Canary Islands, whereas it hibernates or develops only very slowly for a considerable part of the year in Spain. This might prove an obstacle to the establishment of larval parasites that are active at low temperatures.

DEL CAÑIZO (J.) & MORENO [MÁRQUEZ] (V.). **Ideas actuales sobre las plagas de langosta.** [Present Day Ideas regarding Locusts.]—*Bol. Pat. veg. Ent. agríc.* **9** pp. 107–137, 5 figs., many refs.; also as *Trab.* (*Ser. Fitopat.*) *Inst. nac. Invest. agron.* no. 24; also as *Publ. Serv. Lucha contra la Langosta* no. 3. Madrid, 1940.

A brief summary is given of the phase theory [*cf. R.A.E.*, A **26** 677] of locust periodicity, and the outbreak areas of *Dociostaurus maroccanus*, Thnb., in Spain are enumerated and their climate and vegetation described [**26** 698]. Methods of direct control used in Spain [**26** 698] are discussed, and the high cost of their application is illustrated by the example of the campaign in 1922–23 in the province of Ciudad Real, in which over 2½ million pesetas was spent in controlling an infestation covering about 127,000 acres. This suggests the necessity for a preventive policy on the lines of the organisation existing in Algeria [**22** 702; **26** 685; **27** 480]. Preliminary steps in that direction would be the preparation of annual maps of the infested areas, on a scale of not less than 1 : 50,000, and detailed ecological studies on the solitary phase in the outbreak areas. It is recommended that this work should be permanently directed by the Locust Control Service recently established in Spain.

BENLLOCH (M.). **La lucha contra la langosta. Un método para determinar el límite económico del empleo de los cebos y de la gasolina en comparación con el coste de la labor de invierno.** [Locust Control. A Method for ascertaining the economic Limit of the Use of Baits and Gasoline compared with the Cost of Winter Labour.]—*Bol. Pat. veg. Ent. agríc.* **9** pp. 138–144, 2 figs.; also as *Trab.* (*Ser. Fitopat.*) *Inst. nac. Invest. agron.* no. 25; also as *Publ. Serv. Lucha contra la Langosta* no. 4. Madrid, 1940.

To compare the costs of destroying the hoppers of *Dociostaurus maroccanus*, Thnb., in Spain by means of poison baits or by spraying and burning a mixture of gasoline and gas oil with that of destroying eggs by winter ploughing, account must be taken of the increase of the infested area with the hatching and growth of the hoppers. It was established by counts that the number of hoppers occupying 1 sq. metre in the first instar will occupy 2 sq. metres in the second, 5 in the third, 12·5 in the fourth, 30 in the fifth and 100 in the adult stage

[*cf. R.A.E.*, A **19** 410]. On the other hand, the density per sq. metre decreases with age, the average number found being 110,000 hoppers per sq. metre in the first, 44,000 in the second, 20,000 in the third, 7,000 in the fourth, 3,500 in the fifth and 1,200 in the adult stage. Thus, if the number of egg-pods per sq. metre multiplied by 30 (the average number of eggs per egg-pod) be divided by one of the figures for hopper density in a particular instar given above, the figure obtained shows how many times the infested area will have increased when the hoppers are in the instar in question. On this basis, a graph is constructed, with the numbers of egg-pods per sq. metre on the abscissa and the infested area in sq. metres on the ordinate ; straight lines radiating from the zero point serve to determine the areas infested by hoppers of each instar, according to different initial infestations. The average cost of winter ploughing per hectare (10,000 sq. metres) is 137·50 pesetas, which is the cost of spraying 858 sq. metres with the mixture of gasoline and gas oil. A line drawn parallel to the abscissa at 858 sq. metres on the ordinate, intersects the straight lines for the various stages, and shows the degree of initial infestation beyond which spraying becomes more expensive than winter ploughing. For first-instar hoppers, spraying costs more than winter ploughing if the egg-pod densities exceed 304 per square metre ; for the second and third instars, the corresponding numbers of egg-pods are 153 and 63, respectively. In the case of poison bait, the sum of 137·50 pesetas suffices to treat an area of 10,736 sq. metres. The graph shows that hoppers in the second instar from egg-deposits with less than 1,973 egg-pods per sq. metre can be equally, or more profitably, controlled by baits, but for denser infestations ploughing is cheaper. For hoppers in the third and fourth instars, the economic limits for poison baits are at 803 and 320 egg-pods per sq. metre, respectively. In the above calculation it is assumed that all eggs hatch, as they never do in nature, and this works out in favour of poison baits. The figures used in the calculation are not absolutely correct, but this does not invalidate the method of comparing the costs of different treatments.

Moreno Márquez (V.). **La langosta y las roturaciones.** [Locusts and Ploughing.]—*Bol. Pat. veg. Ent. agríc.* **9** pp. 145–153, 7 refs. ; also as *Trab. (Ser. Fitopat.) Inst. nac. Invest. agron.* no. 26 ; also as *Publ. Serv. Lucha contra la Langosta* no. 5. Madrid, 1940.

Although ploughing the areas infested with egg-pods of *Dociostaurus maroccanus*, Thnb., is regularly carried out in autumn or winter in Spain, its effect on the survival of the eggs has not been sufficiently studied ; it was therefore investigated in a series of experiments. Eggs in undamaged egg-pods proved viable after being exposed to a temperature of 0°C. [32°F.] for periods of up to 30 days, but isolated eggs were practically all killed in ten days. When both intact egg-pods and isolated eggs were exposed to normal winter weather for over two months and than incubated in a laboratory, 47 per cent. of the eggs in the pods hatched. Subsidiary experiments showed that the percentage survival varies from 36 to 93, so that from a practical point of view the results were indecisive. To test the effects of deep ploughing, which is supposed to bury the egg-pods so deeply that larvae are unable to reach the surface, several lots of egg-pods were buried at various depths in mixtures of earth and sand in different proportions. No emergence was observed from depths of

more than 4 ins., but it is possible that greater thicknesses might be penetrated in the case of natural soils containing cavities. It might be suggested that ploughing should be deeper than 4 ins., but a general conclusion as to the effectiveness of this control measure cannot be reached without further experiments.

Moreno Márquez (V.). **Seis fórmulas de cebo contra la langosta.** [Six Formulae for Baits against Locusts.]—*Bol. Pat. veg. Ent. agríc.* **9** pp. 154–161, 1 fig.; also as *Trab.* (*Ser. Fitopat.*) *Inst. nac. Invest. agron.* no. 27; also as *Publ. Serv. Lucha contra la Langosta* no. 6. Madrid, 1940.

Experiments with poison baits against *Dociostaurus maroccanus*, Thnb., were carried out in 1940 in a heavily infested area in the Badajoz province of Spain. The infested area had been ploughed in winter, but nevertheless there were extensive hatchings. Six equal areas were treated with baits of different composition, and after 3½ hours counted numbers of hoppers were collected from four different spots in each area and placed in wire cages with wet unpoisoned bran for food; the percentage mortality was estimated every 24 hours for three days. All baits were moistened with water. The best results (99·62 per cent. mortality) were obtained with baits consisting of 100 lb. bran, 8 lb. molasses and 2 lb. sodium fluosilicate or sodium arsenite. A bait of 50 lb. bran, 50 lb. sawdust and 2 lb. sodium arsenite gave 97·42 per cent. mortality and acted more quickly than any other. When used with the same carrier, 4 lb. sodium arsenate gave 93·27 per cent. mortality, and 2 lb. sodium fluosilicate gave 81·92 per cent., but 2 lb. sodium fluosilicate with the addition of 5 lb. common salt gave only 51·80 per cent. It is concluded that the mixture of bran and sawdust is a good carrier, that molasses is unnecessary in baits containing arsenicals, but increases the attractiveness of those containing sodium fluosilicate, and that the effectiveness of the fluosilicate bait is reduced by salt. Sodium arsenate is as effective as sodium arsenite, but is uneconomical, as a double quantity is required.

Ruiz Castro (A.). **La lucha contra la mosca de las frutas** (*Ceratitis capitata* **Wied.**) **con sustancias atractivas. Tres años de experiencias.** [Three Years of Experiments in the Control of *C. capitata* with Baits.]—*Bol. Pat. veg. Ent. agríc.* **9** pp. 162–187, 1 fig., 10 graphs., 11 refs.; also as *Trab.* (*Ser. Fitopat.*) *Inst. nac. Invest. agron.* no. 37. Madrid, 1940.

In 1933–35, experiments were carried out in Almeria with glass bait-traps and (in 1935) with aluminium bowls to ascertain the attractiveness to *Ceratitis capitata*, Wied., of various baits, the protection afforded to oranges and grape-vines by the glass traps, and the possible effect of the height at which the traps were placed. The numbers caught are shown in tables and graphs.

The experiments in 1933 were carried out in fig orchards, in each of which 5 traps containing the baits to be tested were suspended from wooden frames. The catches were counted and the baits renewed weekly from 21st September to 10th November. The total catch rose from 405 at the first count to 985 on 5th October and then fell gradually to 67 in the final count. The total numbers of flies caught were 912 for diluted orange juice, 750 for diluted peach juice, 667

for diluted fig juice, 537 for fermented bran water and 424 for vinegar and water (1 : 3). After 12th October, when the temperature fell considerably, bran water decreased in attractiveness very quickly, but vinegar became more attractive.

In 1934, traps were suspended for 9 weeks in plantations of fig and for longer periods in orange groves and vineyards. Orange juice and peach juice again proved superior, but 1·3 per cent. Clensel was better than either.

In 1935, when aluminium bowls were compared with the glass flasks as containers for the baits, nearly twice as many flies were caught in the latter as in the former. A number of additional baits were tested, including bran water with borax, fig juice with ammonium fluoride, potato water, and ammonium fluoride in water, but orange juice was superior to them all, and was considerably superior to Clensel. From the catches in all three years, efficiency indices were calculated for five attractants ; they are 100 for orange juice, 94 for fig juice (which is not obtainable throughout the season), 74 for peach juice, 49 for vinegar and 44 for bran water.

In 1933 and 1934, the value of glass bait-traps was tested as a protection to the crop. In 1934, a trap was placed in each of 600 vines and 360 orange trees. The total catches in the vines were 2,152 for vinegar, 1,519 for bran water and 3,126 for Clensel. Examination of the harvested crop showed that 0·006 per cent. by weight of the grapes were infested. In the orange groves, the total catches were 7,941, 3,735 and 7,720 for vinegar, bran water and Clensel, and of the estimated number of oranges 0·054 per cent. were infested.

In 1935, glass flasks and aluminium bowls baited with Clensel were placed at heights of 1, 2 and 3 metres in 4 fig trees and 4 orange trees. The glass flasks captured 767, 1,939 and 3,701 flies at the three heights, respectively, and the corresponding figures for the bowls were 747, 1,771 and 3,613.

Bohorquez (R.). **Experiencias de lucha contra la mosca del olivo (*Dacus oleae* Gmel.) por medio de sustancias atractivas.** [Bait Experiments against *D. oleae*.]—*Bol. Pat. veg. Ent. agríc.* **9** pp. 188–204, 5 graphs; also as *Trab.* (*Ser. Fitopat.*) *Inst. nac. Invest. agron.* no. 29. Madrid, 1940.

Further experiments with baits against *Dacus oleae*, Gmel., in Andalucia [*cf. R.A.E.*, A **26** 700] were made in 1937. The numbers of flies caught in olive plantations by each of 10 substances are shown in a series of tables. The largest number (6,987, of which 4,131 were females) was taken with 5 per cent. ammonium phosphate, which attracted very few other insects and appeared to retain its attractiveness for about a fortnight. A 4 per cent. solution of ammonium fluoride caught 2,650 flies, of which 1,629 were females, and was superior to 10 per cent. ammonia in most tests [*cf. loc. cit.*].

Morales Agacino (E.). **Los Gryllotalpinae de España.**—*Bol. Pat. veg. Ent. agríc.* **9** pp. 212–233, 7 figs., 6 pp. refs.; also as *Trab.* (*Ser. Fitopat.*) *Inst. nac. Invest. agron.* no. 41. Madrid, 1940.

Until recently, *Gryllotalpa gryllotalpa*, L., which occurs throughout Spain, was the only species of the genus recorded there, but in 1932, two examples of *G. africana*, P. de B., were taken near Cadiz.

The distribution of this mole-cricket in Spain is still apparently restricted to the valley of the lower Guadalquivir. The author describes the morphology of adults of the genus and of the two species, gives a key to the latter, and lists their synonyms. Present knowledge of the biology of *G. gryllotalpa* is summarised from the literature.

Benlloch (M.). **Comprobación de resultados en la fumigación cianhídrica de naranjos.** [Evaluation of the Results of fumigating Orange Trees with Hydrocyanic Acid Gas.]—*Bol. Pat. veg. Ent. agríc.* **9** pp. 249–253; also as *Trab.* (*Ser. Fitopat.*) *Inst. nac. Invest. agron.* no. 23. Madrid, 1940.

The author discusses the standards that should be observed in estimating the effect of fumigating orange trees with hydrocyanic acid gas against Coccids in Spain and gives a list of the species against which this treatment is applied. The subjects dealt with include the date at which the examination should be made, sampling, microscopic examination and the interpretation of the results.

Benlloch (M.). **Insecticidas pulverulentos.** [Dust Insecticides.]—*Bol. Pat. veg. Ent. agríc.* **9** pp. 254–257; also as *Trab.* (*Ser. Fitopat.*) *Inst. nac. Invest. agron.* no. 34. Madrid, 1940.

The author briefly discusses the advantages and disadvantages of dust insecticides as compared with sprays. Dusts are not generally employed in Spain, the main reason being that the quantity of insecticide needed is greater than with a spray, but their use may be desirable in special cases for treating small plants, on which the amount required is small, or against pests that occur on parts of the plant where they are difficult to wet with a spray.

Mendizábal Villalba (M.). **Dos nuevas plagas de nuestros cultivos meridionales : *Prodenia litura* F. (Lep. Noct.) y *Euprepocnemis plorans* Charp. (Ort. Acr.).** [Two new Pests of cultivated Plants in southern Spain, *P. litura* and *E. plorans*.]—*Bol. Pat. veg. Ent. agríc.* **9** pp. 258–262, 9 figs.; also as *Trab.* (*Ser. Fitopat.*) *Inst. nac. Invest. agron.* no. 42. Madrid, 1940.

Prodenia litura, F., was recorded as a pest of economic importance in Spain for the first time in 1937, when the larvae caused serious injury to kitchen-garden crops, maize and lucerne round Almería. Three generations of the moth were observed, and the egg, larval and pupal stages lasted 2–4, 15–20 and 7 days, respectively. Sprays of lead arsenate were used for control. Infestation recurred in 1940 and control measures were immediately undertaken. Injury in gardens has also been caused in this district by the Acridid, *Euprepocnemis plorans*, Charp., which is believed not previously to have been recorded as a pest in Europe.

Urquijo (P.). **Una plaga de *Lema melanopa* L. en trigos de Galicia.** [An Outbreak of *L. melanopa* on Wheat in Galicia.]—*Bol. Pat. veg. Ent. agríc.* **9** pp. 263–267, 2 figs.; also as *Trab.* (*Ser. Fitopat.*) *Inst. nac. Invest. agron.* no. 38. Madrid, 1940.

In 1938, the wheat crop in a district in Galicia, Spain, was almost totally destroyed by the Criocerid, *Lema melanopa*, L., which is

common but unimportant throughout Europe. Still more damage was caused in 1939, in which year the crop losses were estimated at 600,000 pesetas. Late varieties of wheat, especially those sown in March, suffered most, while those sown in October of the preceding year were not injured, probably because the hardened leaves are unsuitable food. It is considered that attack could be avoided by sowing only in autumn and early winter, but owing to the difficulty of altering customary practice it is suggested that a spray of lead arsenate or a dust of calcium arsenate should be applied.

The adults feed on the leaves of all cereals and other grasses. The narrow, longitudinal lesions do not perforate the leaf blade, but have a translucent appearance. The eggs are laid in May and June in batches of about 30 on the leaves. In Galicia, a few larvae hatched in May, the majority in June. Their feeding intensifies the injury done by the adults, and when the green parts of the leaves are entirely destroyed the ears produce little or no grain. When they are full-fed, the larvae bury themselves to a depth of 2 ins. in the ground, and after a fortnight pupate in a cell, the adults emerging 10 days later. With the advent of cold weather, the adults seek winter quarters at the foot of the plants.

Pequeño (L.). **El embolsado de melocotones como medio de defensa contra la** *Ceratitis capitata* **Wied.** [The Enclosure of Peaches in Paper Bags as a Protection against *C. capitata*.]—*Bol. Pat. veg. Ent. agríc.* **9** pp. 268–272, 3 figs.; also as **El método del embolsado para la defensa de melocotones contra la mosca de las frutas.**—*Trab.* (*Ser. Fitopat.*) *Inst. nac. Invest. agron.* no. 40. Madrid, 1940.

Investigations carried out over a number of years in peach orchards in the region of Barcelona showed that the fruits can be protected from infestation by *Ceratitis capitata*, Wied., by enclosing them in paper bags 25 days before they ripen. Bags made of newspaper were satisfactory, and the treatment led to an improvement in the quality of the peaches. A few of the bagged fruits became infested owing to injury to the bags by *Forficula auricularia*, L., but it is considered that this could be prevented by applying an adhesive to the trunks of the trees or by the use of repellents.

Gómez [Clemente] (F.) & Planes (S.). **Aplicación de la estadistica matemática a las experiencias de lucha contra la** *Ceratitis capitata* **con cazamoscas de vidrio.** [The Application of mathematical Statistics to Experiments in the Control of *C. capitata* with Glass Bait-traps.]—*Bol. Pat. veg. Ent. agríc.* **9** pp. 277–297, 5 refs.; also as *Trab.* (*Ser. Fitopat.*) *Inst. nac. Invest. agron.* no. 43. Madrid, 1940.

In view of the divergent orders of effectiveness shown in individual experiments in Valencia in 1932–34 by 25 per cent. vinegar, 1·5 per cent. Clensel, orange juice and bran water in bait-traps against *Ceratitis* [*R.A.E.*, A **26** 699], a special series of tests was carried out with these baits in 1935, and the results were analysed statistically by the method of R. A. Fisher. The baits were exposed in traps of blue, green, topaz or colourless glass, and four traps were hung in each of 288 orange trees from 27th September to 20th December and examined weekly. The results are tabulated and discussed.

The authors' conclusions are as follows. The trapping with baits is influenced by many factors, including the proximity of winter quarters and of attractive fruits, and the direction of the wind, and these must be eliminated if Fisher's method is to be applied to the results. An increase in the number of repetitions of a test only increases the effect of the unknown factors, and using traps of different colours falsifies the results due to the attractiveness of the baits. In future work, it is proposed to use colourless glass traps in wire gauze cages in which a given number of pupae of *C. capitata* have been placed in the soil, thus eliminating extraneous factors.

Smith (J. H.). **Report of the Entomological Section.**—*Rep. Dep. Agric. Stk Qd 1939–40* repr. pp. 6–8. Brisbane, 1940.

An account is given of entomological work in Queensland in 1939–40 [*cf. R.A.E.*, A **28** 590]. Continuous records were kept of the emergence of adults of the codling moth [*Cydia pomonella*, L.] on apple by means of traps [*cf.* **29** 238] baited with wine and water (1 : 9), and cover sprays of white oil or white oil and nicotine sulphate, following lead arsenate in the calyx spray, gave satisfactory control. The choice of a cover spray against *C. pomonella* now depends to a great extent on the status of other pests present. *Dacus* (*Strumeta*) *ferrugineus tryoni*, Frogg., was of minor importance in the Stanthorpe district. In experiments on the sources of the spring infestation of stone fruits by this Trypetid, infested fruits were placed in cages in the autumn of 1939 and kept in sheltered places ; 90 per cent. of the pupae gave rise to adults in late autumn or early winter, none of which was alive in the spring, and the other pupae and all larvae present died when cold weather set in. It is concluded that spring infestation must be due to immigration [*cf.* **25** 164]. Work on baits for the control of this Trypetid on *Citrus* indicated that the addition of vanilla contributes little to the effectiveness of baits containing ammonia.

In tests of sprays of derris and pyrethrum applied in summer for the control of the bronze orange bug, *Rhoecocoris sulciventris*, Stål [on *Citrus*], high concentrations of derris gave good mortalities. The fourth-instar nymphs were more resistant than the adults. The possibility is now being investigated of combining derris with a spray effective against Coccids and using the mixture instead of the standard autumn spray against *Rhoecocoris* [**28** 591]. Other pests observed on *Citrus* were the bud mite, *Eriophyes sheldoni*, Ewing, which occurs in most of the coastal and subcoastal areas of the State, and the Eumolpid, *Colasposoma sellatum*, Baly, which defoliated the trees in one district. *Tenuipalpus californicus*, Banks, and *T. australis*, Tucker, were associated with injury to passion vines [*Passiflora edulis*] ; these two mites are not very susceptible to lime-sulphur but can be controlled by sprays of white oil. *Myzus persicae*, Sulz., was unusually troublesome on peach.

Double tubes of brown paper gave satisfactory protection against *Scirtothrips signipennis*, Bagn., on banana [*cf.* **29** 436]. This thrips has declined in numbers of recent years throughout the State. Cavendish bananas, which are the most important commercial variety in Queensland, though susceptible to infestation by *S. signipennis*, are not attacked by the Eumolpid, *Rhyparida morosa*, Jac., in northern districts, whereas the variety Ducasses is apparently resistant to the thrips but readily attacked by *R. morosa*. A second consignment of

the predacious Hydrophilid, *Dactylosternum hydrophiloides*, Macleay, was received from Malaya [*cf.* **28** 591] against the banana weevil borer [*Cosmopolites sordidus*, Germ.] and released in two localities. Reproduction occurred in both, and dispersal is in progress. The predator is considered to be thoroughly established.

Strawberry pests, of which the most important is *Anaphothrips* (*Neophysopus*) *fragariae*, Gir., caused little damage during the season under review. Experiments on the control of tomato pests in the central district were terminated by hail but indicated that dusting is preferable to spraying, even though it decreases parasitism of the eggs of *Heliothis armigera*, Hb. (*obsoleta*, F.), and that crops should be treated at least every three weeks after flowering begins. French beans were attacked by *Taeniothrips usitatus* var. *cinctipennis*, Bagn.

An outbreak of *Chortoicetes terminifera*, Wlk., was the most severe on record in Queensland. Flying swarms appeared in late November and early December in the Darling Downs and other sub-coastal areas ; the main invasion entered Queensland from New South Wales, and egg-laying in important agricultural areas was very extensive. The hoppers hatched in late December and January and attacked fodder crops. The adults of this generation left the infested areas, and the outbreak was rapidly terminated. Cotton was attacked in the early summer by *C. terminifera* and, somewhat unusually, by nymphs and adults of *Austracris guttulosa*, Wlk. The yield of cotton infested by *H. armigera* was not increased in one district by dusting with lead arsenate or swabbing with lead arsenate and molasses. Observations showed that the potential increase in yield that should follow destruction of the larvae is offset by the harmful effect of the insecticides on the plants, and that their use is not justified unless the expected yield of cotton is two bales or more per acre. Local injury to cotton was caused by *Laphygma* (*Spodoptera*) *exigua*, Hb., which occurred sporadically, and by the flea-beetle, *Podagrica* (*Nisotra*) *breweri*, Baly, which was active in spring. The Cecidomyiid, *Contarinia sorghicola*, Coq., was very destructive to grain sorghum on the Darling Downs, and occurred in association with *Aphis maidis*, Fitch ; sorghum is also attacked by various Lepidoptera, including *H. armigera*. The Cecidomyiid seemed to thrive in most areas, free-tillering varieties and late-planted crops suffering most. Its abundance depends on the amount of grain sorghum grown and the presence of grass sorghums, which serve as alternative food-plants.

Late-emerging adults of the Melolonthid, *Lepidiota caudata*, Blkb., were unusually abundant in January in pasture land on the Atherton Tableland, but egg-laying was apparently comparatively light. The felted grass Coccid, *Antonina* sp., infested pastures of Rhodes grass [*Chloris gayana*] in some parts in the north, and lawns of couch grass [*Agropyrum repens*] in both coastal and inland areas. It may also have been responsible for pasture failure in one locality in which the Tineid, *Opogona cleonyma*, Meyr., is commonly associated with the roots of Rhodes grass at certain times of the year and is believed to be the cause of the damage.

Further investigations on the value of high ring-barking of hardwood timber trees to reduce the starch content and thus prevent infestation of the sawn timber by *Lyctus brunneus*, Steph. [*cf.* **28** 592] showed that starch depletion is almost complete within 2–4 months in summer and 6 months in winter. The method can thus be applied at any season if logging operations are arranged accordingly. The development of

coppice of even a year's growth below the level of the ring did not materially augment the starch content of the sapwood in the bole. Treating felled logs with creosote at the rate of 1 gal. per 150 sq. ft. of log surface prevented attack by Platypid borers [*cf. loc. cit.*] for at least 10 weeks. Logs treated after felling and again on two occasions after rain were in excellent condition after 9 months. Witches' broom effects in narrow-leaved ironbark [*Eucalyptus crebra*] are now known to be caused by the Coccid, *Maskellia globosa*, Fullaway; and a Cerambycid that severs the branches of hoop pine [*Araucaria cunninghami*] has recently been described by McKeown as *Strongylurus* (*Coptopterus*) *decoratus*.

Teleonemia scrupulosa, Stål (*lantanae*, Dist.) has become firmly established [on *Lantana camara*] in coastal areas north of Townsville following liberation in 1939, and conditions in the far north are apparently very favourable for this Tingid [*cf.* **28** 317]. The Hypsid, *Digama marmorea*, Btlr., was probably responsible for considerable defoliation in late summer and autumn of the so-called wild blackberry, *Carissa ovata*, which has recently become an important weed in pastoral areas near Emerald. Such attacks are apparently not uncommon, but exercise only a temporary check.

ZECK (E. H.). **Insect Pests of the Kurrajong.**—*Agric. Gaz. N.S.W.* **51** pt. 12 pp. 679–681, 6 figs. Sydney, 1940.

Systematic planting of kurrajong [*Brachychiton populneus*] is being encouraged in New South Wales as a means of providing shelter and drought fodder for stock, and protecting the soil from erosion. In addition to the weevils, *Axionicus insignis*, Pasc., and *Tepperia sterculiae*, Lea [*cf. R.A.E.*, A **26** 404], this tree is attacked by two Psyllids, *Tyora sterculiae*, Frogg., and *Psylla sterculiae*, Frogg. The eggs of *Tyora* are deposited in groups of 30–40 on the upper surfaces of the leaves, while those of *Psylla* occur at the tips of the young twigs or on the young foliage between the forks of branchlets. The nymphs and adults of the latter cluster round the twigs, secreting large quantities of honey-dew, which attracts ants. The larvae of *Sylepta clytusalis*, Wlk., feed on the leaves, rolling and matting them together with silken strands to form an irregular cylindrical mass of closely rolled leaves and twigs about 9 ins. long. Pupation occurs in cells formed by drawing the sides of the leaves together. The larvae of the Nitidulid, *Circopes pilistriatus*, Macleay, feed among the seeds and on the soft inner skin of the pod. Fleshy galls sometimes develop on the small branches and twigs of the tree, but their cause is not yet known. Several Chalcidoids have been bred from them, in addition to the weevil, *Tepperia sterculiae*. Brief notes are given on the appearance of various stages of all these pests, together with suggestions for sprays that might be effective against some of them.

EVANS (J. W.). **The Cabbage Butterfly.**—*Tasm. J. Agric.* **11** no. 4, pp. 202–204, 3 figs., 1 ref. Hobart, 1940.

Large numbers of white butterflies, believed to be *Pieris rapae*, L., were seen flying inland over the north-western coast of Tasmania on 1st January 1940. Notes are given on the bionomics of this Pierid and the injury it causes to cruciferous crops, together with brief descriptions of all stages. The adults are migratory and presumably reached

Tasmania from Victoria, where the butterfly was first recorded in 1939 [*cf. R.A.E.*, A **28** 47] and is now widely distributed [**29** 290]. Control measures comprising dusting with lead arsenate and nicotine are suggested. Arrangements have been made to introduce the pupal parasite, *Pteromalus puparum*, L., from New Zealand [*cf.* **28** 27] as soon as the presence of the butterfly in Tasmania is confirmed.

HUSTACHE (A.). **Curculionides nouveaux du Brésil.**—*Rev. Ent.* **11** fasc. 3 pp. 690–713. Rio de Janeiro, 1940.

Descriptions are given of a number of new weevils from Brazil, the majority from palms (*Cocos* and *Attalea*). They include *Phytotribus platyrhinus*, *Hoplorrhinus testaceus* and *H. unicolor* from *Cocos coronata*, and *Derelomus bondari*, *Ancylorrhynchus trapezicollis*, *Pseudocentrinus lucidulus* and *Tonesia bondari* from *C. coronata* and coconut (*C. nucifera*). Brief preliminary descriptions of the last four were given in a work already noticed [*R.A.E.*, A **28** 581], and two of them were mentioned in another paper [**29** 10].

CALLAN (E. McC.). **The Gall Midges (Diptera, Cecidomyidae) of the West Indies.**—*Rev. Ent.* **11** fasc. 3 pp. 730–758, 14 refs. Rio de Janeiro, 1940.

In this paper, the author collates records of Cecidomyiids in the West Indies and reviews existing knowledge on them, with notes on the bionomics and economic importance of some of them. Of the 57 species dealt with, 15 are known to be predacious on other insects or mites and 18 cause galls on the leaves and stems of plants. Those that are pests of crops have already been noticed [*R.A.E.*, A **28** 632].

BONDAR (G.). **Notas entomologicas da Bahia. VI.**—*Rev. Ent.* **11** fasc. 3 pp. 842–861, 8 refs. Rio de Janeiro, 1940.

This part of a series on insect pests in Bahia [*cf. R.A.E.*, A **29** 9] includes an account of further observations on *Himatidium neivai*, Bondar, on coconut (*Cocos nucifera*) [*cf.* **29** 10]. All of about one hundred dwarf coconut palms in a plantation were infested, and attack by this and other pests reduced the crop to about two thousand nuts, instead of a normal 15–20 thousand. Dwarf coconut seems more liable to attack than the commoner Brazilian varieties. *Cocos botryophora*, which occurs in various parts of Brazil, is the original food-plant of this beetle, which can be easily controlled by spraying with Paris green. When establishing new plantations, native palms, especially *C. botryophora*, should be destroyed in the vicinity. From the structure and habits of the larva of *H. neivai*, the author thought it probable that the genus should be transferred from the Cassidids to the Hispids. He therefore submitted material to S. Maulik, who confirmed this opinion.

The food-plants of some other Brazilian Hispids are recorded, and descriptions are given of the weevil, *Balanoecus* (*Balanephagus*) *gica*, sp. n., which infests the internal spathes of *Cocos coronata*, and of the Colydiid, *Bitoma palmarum*, sp. n., which infests the flowers of coconut and *Attalea funifera*.

The author also gives the text of a paper on the entomology of the flowers of palms in Brazil forwarded to the Eighth American Scientific

Congress held at Washington in May 1940. The species recorded from coconut were all mentioned in a work already noticed [**28** 581], except a weevil that is to be described by Hustache in a new genus as *Catolellerus strangulatus*.

Townsend (C. H. T.). **New Oestroid Flies from Brazil.**—*Rev. Ent.* **11** fasc. 3 pp. 889–894. Rio de Janeiro, 1940.

The new Tachinids described include *Paraphasiana dysderci*, gen. et sp. n., reared from adults of *Dysdercus ruficollis*, L., and *D. mendesi*, Blöte, and *Winthemia* (*Hemimasipoda*) *alabamae*, sp. n., from *Alabama argillacea*, Hb., both in São Paulo, Brazil.

Report of the Puerto Rico Experiment Station, 1939.—126 pp., 43 figs., 16 refs. Washington, D.C., 1940.

In the section on vanilla investigations (pp. 2–27), it is stated that larvae of the Arctiid, *Ecpantheria icasia*, Cram., caused severe damage from October 1938 to January 1939 to vanilla plants at the Experiment Station in Porto Rico. In a young plantation of the support tree, *Erythrina berteroana*, many young shoots were killed by *Terastia meticulosalis*, Gn. Two wasps, *Mischocyttarus phthisicus*, F., and *Polistes major*, P. de B., were predacious on the larvae of this Pyralid.

In the section on vegetable crop investigations (pp. 45–62), it is reported that *Peregrinus maidis*, Ashm., was numerous on young maize soon after germination, and many plants were affected by corn stripe, a virus disease of which this Delphacid is the vector. An experiment indicated that annual teosinte (*Euchlaena mexicana*) is quite as susceptible to infestation by *Elasmopalpus lignosellus*, Zell., as sweet maize, most of the plantings of which on one property have been destroyed by this Pyralid of recent years.

In an experiment to test the effectiveness against earworms in maize of various combinations of clipping the ends of the ears, covering them with tightly fitting glassine bags and applying a light, highly refined mineral oil to the ends of the husks and silks, 96·7 per cent. of the untreated ears were infested by *Euxesta stigmatias*, Lw., and 53·3 per cent. by either *Heliothis armigera*, Hb., or *Laphygma frugiperda*, S. & A., whereas a combination of all three treatments resulted in 82·7 per cent. control of *E. stigmatias* and 87·4 per cent. of the two Lepidoptera. When the ears were not covered, the percentage control of the latter by the other two treatments was 75, but that of *E. stigmatias* was less than 30, and when the oil treatment was omitted it was 33 and 74·1 respectively. Clipping the ears reduced the percentage control of *E. stigmatias* given by 1 or 2 applications of mineral oil in further experiments from 4·8 and 10·5 and 1·5 and 0, respectively, but mineral oil both alone and in combination with clipping gave excellent control of *H. armigera* and *L. frugiperda*. All treatments including mineral oil were statistically equal, the percentage control ranging from 88·3 to 95·4. Clippings from ears heavily infested with all three insects were saturated with mineral oil or with a mixture of pyrethrum extract (2·4 per cent. pyrethrins) and mineral oil (1 : 3) or left untreated. They were then kept moist in bags. Four days later, the untreated clippings were heavily infested by all three species, those treated with mineral oil alone were heavily infested by *E. stigmatias* only, while those treated with the mixture were free from living larvae of any

species. In field experiments, two applications to the unclipped ears of the mixture gave complete control of all three pests, whereas two of oil alone gave complete control of the Lepidoptera, but only 2 per cent. control of *E. stigmatias*. During late May, a mixture of pyrethrum extract and mineral oil (1 : 4) was tested against *E. stigmatias* in seed ears of sweet maize that were ten days older than those previously treated and of which most were already heavily infested. The ears were harvested and examined three weeks after treatment. Of the untreated ears, 96·3 per cent. had been damaged by larvae of *E. stigmatias*, whereas only 2·5 per cent. of the treated ears showed signs of injury. In further tests, the percentages of infested ears following applications of mixtures in which the ratios of pyrethrum extract to oil were 1 : 5, 1 : 25, 1 : 50, 1 : 75 and 1 : 100 were 11·1, 68·1, 94·4, 97·2 and 97·2 when one application was made, and 6, 33·3, 77·4, 90·5 and 94 for two applications. Only the mixture in the proportion of 1 : 5 was sufficiently effective to afford good commercial control. The addition of derris powder at the rate of 1 oz. per U.S. quart did not increase the effectiveness of the 1 : 5 mixture in controlling *E. stigmatias*, but increased the percentage control afforded by the 1 : 25 mixture from 15·8 to 77·2.

Empoasca fabalis, DeLong, injured the leaves of small-seeded varieties of lima beans [*cf. R.A.E.*, A **27** 501], while those of large seeded varieties were infested but not injured. The yellowing and mottling of the leaves appeared to be caused by the feeding of the Jassid, and not by a virus.

The section on investigations of insecticidal plants (pp. 71–93)* includes the results of work on the physiological structure of roots of *Lonchocarpus* spp., *Derris elliptica* and *Tephrosia toxicaria* and the effects of starvation by defoliation on rotenone and total extractives in the roots of the last two. Acetone extracts of the roots of bushy small-leaved *Lonchocarpus* plants were more toxic to house-flies [*Musca domestica*, L.] than those of tall large-leaved plants, but the latter produce more roots than the former.

In the section on biological control activities (pp. 102–111), an account is given of work on the collection in São Paulo, Brazil, and the subsequent introduction into Porto Rico of three parasites of the sugar-cane borer, *Diatraea saccharalis*, F. The most numerous of these was *Metagonistylum minense*, Tns., which differed in colour from the material of the Amazon strain previously introduced from British Guiana [*cf.* **27** 505 ; **28** 651] and is referred to as the São Paulo strain [*cf.* **26** 82]. The others were *Theresia claripalpis*, Wulp, and *Microdus* (*Bassus*) *stigmaterus*, Cress. The percentage parasitism of larvae of *D. saccharalis* in material collected near Piracicaba was 33·9 by *Metagonistylum*, 2·8 by *Theresia* and 1·2 by *Microdus*, while at Campinas, where *Metagonistylum* was the only parasite reared, it was 39·3. At Piracicaba and Campinas, 23·8 and 30·8 per cent., respectively, of the puparia of *Metagonistylum* collected in the field were parasitised by a Diapriid of the genus *Trichopria*. The puparia sent to Porto Rico were doubly caged on arrival, but no hyperparasites emerged. Shipments of the parasites were made in March, chiefly by air, and of the 20 adults of *Metagonistylum* sent 9 reached Porto Rico alive, while 155 emerged from the 243 puparia. From the 9 puparia of *Theresia*, 7 adults emerged. The two adults of *Microdus* reached Porto Rico

* We are informed that a detailed abstract of this section will appear in the *Bulletin of the Imperial Institute*, 1941, No. 3.—*Ed.*

alive, and adults emerged from the two cocoons. Breeding of *Metagonistylum* and *Theresia* was carried out in the laboratory, and 1,637 adults of the former were liberated at Guayama, where the rainfall is similar to that at Piracicaba. Three adults of *Microdus* from Brazil were liberated at Santa Isabela ; this Braconid, which is known to be parthenogenetic, already occurs in areas of high rainfall in Porto Rico [*cf.* **27** 502], but it is hoped that the São Paulo strain will prove more suited to a drier area. Breeding of the Amazon strain of *Metagonistylum* was continued [*cf.* **28** 651], and 8,787 adults were released in 6 localities. Collections showed that this strain is apparently established on the south coast, where the highest percentage parasitism was 5·7. A shipment of seven mated females of the Amazon strain was sent to Trinidad, where all arrived in good condition, and 40 mated females of the São Paulo strain were dispatched to Louisiana [*cf.* **29** 354], 32 of which were alive on arrival. Rearing and liberation of *Theresia claripalpis* from Trinidad [*cf.* **28** 492] was continued and 908 adults were released at Guayama.

A consignment of 1,100 adults of *Macrocentrus gifuensis*, Ashm., reared from larvae of *Pyrausta nubilalis*, Hb., collected in Massachusetts, was received for trial against *D. saccharalis*. Of the 485 adults that were alive on arrival, 463 were liberated on 24th March at Guayama ; a few were kept in the laboratory and given larvae of *D. saccharalis* in sugar-cane and Guatemala grass [*Tripsacum laxum*], but no evidence of oviposition was seen, nor were any parasites reared.

Rearing of the Coccinellid, *Coelophora inaequalis*, F. [*cf.* **27** 382], which is predacious on *Sipha flava*, Forbes, on sugar-cane, was continued during the year ; liberations were made in five areas where infestation by the Aphid was heavy, and within a few months recoveries were made at all liberation points. The breeding of *Dirhinus giffardi*, Silv., a pupal parasite of *Anastrepha mombinpraeoptans*, Seín, and *A. suspensa*, Lw., was continued [*cf.* **28** 492] on a small scale, and 4,978 adults were liberated at 8 localities. A shipment of 1,300 adults of *D. giffardi* was forwarded to the Dominican Republic, and all were alive on arrival.

Collections of Coccinellids predacious on the bamboo scales, *Asterolecanium bambusae*, Boisd., and *A. miliaris*, Boisd., were made in Trinidad and Brazil, and forwarded to Porto Rico, where releases were made in two localities. Those released comprised 555 of *Azya* sp., near *luteipes*, Muls., 970 of *Exochomus orbiculus*, Weise, 4 of *Ladoria desarmata*, Muls., and 161 of *Pentilia egena*, Muls., from Brazil, and 24 of *Azya trinitatis*, Mshl., 375 of *Curinus* sp., 107 of *Delphastus* sp., 116 of *P. castanea*, Muls., 18 of *Scymnus* sp., and 5 unidentified individuals from Trinidad. A consignment of *Hyperaspis billoti*, Muls., which was collected while feeding on *Chrysomphalus ficus*, Ashm. (*aonidum*, auct.), *Lepidosaphes beckii*, Newm., and *Prontaspis citri*, Comst., on *Citrus* was also received from Trinidad, and 140 adults were liberated at Rio Piedras on a wild orange tree infested by *Selenaspidus* (*Pseudaonidia*) *articulatus*, Morg., in February 1939. As a result of their introduction in 1938 [**28** 493], *Pentilia castanea*, *Chilocorus cacti*, L., the Martinique species of *Curinus*, and *Egius platycephalus*, Muls., are well established ; all four attack *Asterolecanium bambusae* and *A. miliaris*, while the first two also attack *Aulacaspis pentagona*, Targ. *Azya trinitatis* and *Cryptognatha nodiceps*, Marsh., continued to check *Aspidiotus destructor*, Sign., on coconut. A consignment of 825 adults of *P. castanea* and 120 of *C. nodiceps* was

sent by air to Florida in September for liberation against *A. destructor*, and 344 and 115 were alive on arrival, while 479 adults of *Azya trinitatis*, 79 of *C. nodiceps*, and 506 of *P. castanea* were forwarded, also by air, to Hawaii in June, 437, 75 and 487 of which, respectively, arrived alive.

The rearing and distribution of *Anagyrus coccidivorus*, Doz., which parasitises *Pseudococcus brevipes*, Ckll., on pineapple, were continued [*cf.* **28** 493], while 154 adults of *Hambletonia pseudococcina*, Comp., were recovered from this mealybug and redistributed. Three shipments of *Pseudococcus nipae*, Mask., parasitised by *Pseudaphycus utilis*, Timb., were received from Hawaii, the last shipment yielding 386 parasites, which were liberated at two points on plants infested by *Pseudococcus nipae*, which is a serious pest of palms and avocado in Porto Rico. When collections of *P. nipae* were made in June, the percentage parasitism by *Pseudaphycus* was 18 on avocado, 53·5 on guava and 94 on mamey [*Mammea americana*]. On 6th June, a shipment of puparia of *Dasyscapus parvipennis*, Gah., a parasite of thrips, was sent by air to Florida.

In the section on entomological investigations (pp. 111–117), an experiment is recorded in which bamboo culms were stored for 26 months in a dry loft where *Dinoderus minutus*, F., had free access to them. Their examination then showed that *Bambusa arundinacea*, *B. tulda* and *Dendrocalamus giganteus* were all resistant to attack by this Bostrychid, only 3·18, 6·35 and 0 per cent. of the originally undamaged internodes, respectively, being infested [*cf.* **27** 501], whereas in *B. vulgaris*, *B. balcooa*, and *D. strictus*, these percentages were 77·22, 40·2 and 49·09.

Larvae of an undescribed Tineid of the genus *Kearfottia* were abundant on old infestations of *Asterolecanium bambusae* and *A. miliaris* on bamboo and were reared in cages containing bamboo twigs infested by the Coccids. They were seen feeding on living Coccids, but they also fed on dead ones and on lichens, both of which were abundant on the culms, so that they may act primarily as scavengers. Adults of a Bethylid, probably of the genus *Perisierola*, were found in a cage that had contained *Kearfottia* larvae and were quite possibly parasitic on them.

An experiment was begun in 1935 to compare the effectiveness of two methods of protecting young coconut palms from attack by adults of *Strategus quadrifoveatus*, P. de B. In one treatment, the nut and lower five inches of the trunk of the seedling palm were dipped in a mixture of lime-sulphur and gas tar, while in the other, these parts were wrapped in galvanised iron wire netting with half-inch meshes, through which the beetles cannot pass. Treated and untreated palms were planted about 20 ft. apart between rows of well established palms. The seedlings were examined periodically, and in June 1937, about 20 months after planting, 95·8, 84·9 and 13·3 per cent. of the untreated, dipped and wrapped palms, respectively, had been attacked by the Dynastid. Most of the dipped palms and nearly all the untreated ones that were attacked had died, but only one wrapped one had succumbed. The palms become more resistant to attack as the trunks lengthen and thicken, and in June 1939 (about 43 months after planting) a further examination showed that among 23 untreated palms, 32 dipped ones and 27 wrapped in wire, the percentages killed by the beetle were 87, 84·4 and 3·7, and the percentages free from beetle injury were 0, 6·2 and 59·3, respectively. Wrapping in wire did not

normally impede the development of the roots or trunk, and in most of the cases where wrapped palms had been attacked, the beetles had gained foothold on soil thrown up in cultivation to almost the top of the wire, the attack was made some distance above the growing point and the damage was not serious.

Early in January, the leaflets of *Tephrosia toxicaria* and *T. vogeli* in pots were attacked by larvae of a Tineid of the genus *Lithocolletis* (*Phyllonorycter*) that burrowed between the upper and lower surfaces, causing them to turn brown and drop prematurely. Where plants of both species were grown under cloth shade in a greenhouse, *T. toxicaria* was more severely infested than *T. vogeli* and defoliation was considerable, Plants in the open showed little injury. By summer the greenhouse plants, having been transferred from shade to full sunlight, had recovered and showed few signs of infestation. The larvae were parasitised by two undescribed Eulophids, *Elachertus* sp. and *Zagrammosoma* sp.

In April, larvae and adults of a Chrysomelid identified as *Leucocera laevicollis*, Weise, were observed feeding on young leaves of *Malpighia punicifolia*. The infestation prevented the normal leafing of five trees, and by the end of May practically all the leaves had been consumed and the bark of twigs up to just over $\frac{3}{4}$ inch diameter was being attacked. Subsequent feeding was so severe that the trees were kept leafless, one died, and most of the remainder were being killed by girdling.

MARTORELL (L. F.). **Some Notes on Forest Entomology. IV.**—*Caribb. Forester* **2** no. 2 pp. 80–82. Rio Piedras, P.R., 1941. (With a Summary in Spanish.)

The most important of the termites that attack forest trees in Porto Rico is *Eutermes* (*Nasutitermes*) *costalis*, Hlmgr. [*cf. R.A.E.*, A **27** 464], which also attacks ornamental and shade trees, while the most injurious on Mona Island is *Calotermes* (*Kalotermes*) *snyderi*, Light, which tunnels in living trees and dead wood. Lists are given of the trees from which these termites have been recorded. *C.* (*K.*) *pubescens*, Snyder, attacks forest trees at altitudes of more than 2,000 ft. in Porto Rico and has also been observed infesting timber in old cottages. Less important species are *Eutermes* (*Nasutitermes*) *acajutlae*, Hlmgr., and *E.* (*N.*) *discolor*, Banks, which attack trees at low altitudes and at 2,500 ft., respectively. During August 1940, an outbreak of the weevil, *Prepodes quindecimpunctatus*, Ol., the appearance of which is briefly described, was observed on the foliage of *Torrubia fragrans* in one locality. *Zethus rufinodus*, Latr., has caused considerable damage to fence posts, notably those of *Elaphrium simaruba*. This Eumenid also occurs on Mona Island, where the adults have been observed on flowers of *Lantana camara*.

JAMIESON (C. A.). **A Dipterous Parasite** (*Myopa* **sp.**) **of the Honeybee.**—*Sci. Agric.* **21** no. 5 p. 244, 1 ref. Ottawa, 1941.

On 9th July 1940, a Conopid larva, later determined as *Myopa* sp., was discovered within the abdomen of a worker honey-bee at Ottawa. The slightly swollen abdomen of the bee was the only external evidence of parasitism and there was no internal injury. Numerous bees were examined but no other larvae were found, and this is believed to be

the first record of a species of the genus *Myopa* attacking honey-bees, at any rate in North America. The general life-history of Conopid parasites is briefly outlined from a paper already noticed [*R.A.E.*, B **16** 139], in which it is stated that larvae of the genus *Myopa* parasitise *Vespa vulgaris*, L., and species of *Andrena*, *Bombus*, *Eucera* and *Colletes* in Europe.

SMITH (S. G.). **A new Form of Spruce Sawfly identified by Means of its Cytology and Parthenogenesis.**—*Sci. Agric.* **21** no. 5 pp. 245–305, 6 pls., 83 figs., 63 refs. Ottawa, 1941.

This paper contains a brief review of the cytology of parthenogenesis and a detailed account of investigations on the identity and origin of the Canadian form of the spruce sawfly, *Gilpinia* (*Diprion*) *polytoma*, Htg., some of the results of which have already been noticed [*R.A.E.*, A **26** 215]. In addition to differences in habit [*loc. cit.*], parthenogenesis is obligatory in the Canadian form, whereas in the European form it is facultative. The presence of a single female with 14 chromosomes in a collection from Czechoslovakia [*loc. cit.*] indicated the possibility of the existence of an obligatory form in Europe, and when progeny was reared from unmated females from 15 different localities in Czechoslovakia, the facultative form was found to occur in 8 and the obligatory in 6.

In attempts to correlate type of parthenogenesis, chromosome number and adult morphology, made independently by the author and W. A. Reeks, all males of the facultative type were found to possess 6, and all females of the obligatory type 14, chromosomes. In each sex, the genitalia of adults of the obligatory type from Canada and Europe were identical, but differed from those of adults of the facultative form. Both forms were found in collections from Sweden, Finland, Rumania and Czechoslovakia, but the obligatory form appeared to be the less widely distributed. The author concludes that the European obligatory form and the Canadian form are identical and that the latter originated in Canada by introduction.

The general applicability of P. W. Whiting's theory of sex-determination by sex chromosomes in *Microbracon hebetor*, Say (*Habrobracon juglandis*, Ashm.) is discussed in the light of this investigation and a consideration of the various mechanisms regulating sex-determination in obligatory forms. A hypothesis based on the effect of temperature and the determination of the rate of development by multiple factors is tentatively presented to explain the natural occurrence of males in the progeny of the obligatory form of *G. polytoma* and their greater frequency in certain laboratory rearings. It was observed in the rearing experiments that the European obligatory form produced fewer offspring than the facultative one, the number of cocoons per female averaging 6·6 and 21·7, respectively. It is shown that the difference in fecundity might be due to the presence of recessive lethal genes in the former, and the effect that their presence would have in controlling the outbreak in Canada is briefly discussed.

MATHIS (W.). **Notes on the Biology of the Florida Red Scale (*Chrysomphalus aonidum* L.).**—*Florida Ent.* **24** no. 1 pp. 1–5. Gainesville, Fla., 1941.

Investigations on the seasonal history of *Chrysomphalus ficus*, Ashm. (*aonidum*, auct.) on *Citrus* in Florida were carried out in 1937 and

1938, and studies on its bionomics were made in 1939 under conditions as nearly natural as possible. The technique is described. Active crawlers were found in all months of the year, and reproduction was continuous, with peaks in spring and late summer [*cf. R.A.E.*, A **27** 256]. Of 77 crawlers placed on orange leaves, only 39 were able to settle. The percentage mortality was thus 50 during favourable weather and would presumably be much increased under adverse conditions. The duration of development from the crawler stage to the beginning of oviposition averaged 74 days and ranged from 52 days when settling occurred in August to 95 when it occurred in February. A generation from crawler to crawler required less than 60 days during the summer, while the span of life for the ovipositing females from crawler to death averaged 84 days and ranged from 56 days in August to 110 in January. The average time spent in the adult stage by ovipositing females was 58 days, with a range of 28 to 80 days.

WATSON (J. R.). **Bouncing Buds.**—*Florida Ent.* **24** no. 1 p. 5. Gainesville, Fla., 1941.

Buds pulled from branches of two Chickasaw plum trees [*Prunus angustifolia*] in Florida late in February 1940 and placed in piles were observed by Dr. W. A. Murrill to jump about, covering as much as an inch or two in one jump, and were then found to be infested with Curculionid larvae. More buds were collected, and a considerable percentage of them were infested ; such buds dropped from the trees without opening and the larvae pupated in the soil. Individuals reared in the laboratory were identified as *Anthonomopsis mixtus*, Lec., and were found to be highly parasitised by a Pteromalid of the genus *Zatropis*. No opportunity of obtaining another generation occurred, since by the time the weevils emerged the plum blossom was over.

SPENCER (H.). **The Small Fire Ant** *Wasmannia* **in Citrus Groves.—A Preliminary Report.**—*Florida Ent.* **24** no. 1 pp. 6–14, 6 refs. Gainesville, Fla., 1941.

The following is the author's summary : The small fire ant (*Wasmannia auropunctata*, Roger) [*cf. R.A.E.*, A **17** 383, 612] has interfered with picking and pruning operations in infested *Citrus* groves in Florida by stinging workers severely. A survey has disclosed a number of infestation spots of limited area in the middle and lower East Coast section of Florida, in central Florida, and on the lower West Coast of the State. Normally, the ants feed on honeydew from scale insects, whiteflies, mealybugs, and Aphids, which attack *Citrus*, and also eat dead animals and insects, and juices from fallen fruits. They nest on the ground under slight protection, and in trees ; heavily infested groves contain a vast network of scattered breeding foci with interconnecting trails which extend up tree trunks and branches to the leaves, where the honeydew is obtained.

Preliminary work on control indicates the advisability of reducing natural food supplies by thorough spraying for control of honeydew producers. Banding of tree trunks may bar the ants from access to trees and lessen the number of stings for fruit pickers. The use of a can of Argentine ant bait [*cf.* **24** 771, etc.] on each tree trunk has reduced the numbers of ants in groves to levels at which pickers are not seriously inconvenienced, but, even with two years of baiting, complete eradication has not yet been attained.

Travis (B. V.). **Notes on the Biology of the Fire Ant** *Solenopsis geminata* **(F.) in Florida and Georgia.**—*Florida Ent.* **24** no. 1 pp. 15–22, 10 refs. Gainesville, Fla., 1941.

The following is taken from the author's summary. The biology of *Solenopsis geminata*, F., has been studied in northern Florida and southern Georgia. The mound of this ant is a high, irregularly shaped pile of earth, with lateral tunnels that radiate from 6 ins. to more than 100 ft. from the mound, and with vertical tunnels that extend 6 or more feet deep. The ants are omnivorous, but feed mainly on small seeds, which they store abundantly in their nests. They seem to take only the juices from their food materials and discard the solid portions.

An accurate study of migration has not been possible because the ants move readily through underground passages. Some colonies never seem to have a permanent nest-site, while others have been observed to remain in the same situation for at least 4 years. Colonies have been observed to remain inactive for as long as 8 months. Captive mother queens laid as many as 1,123 eggs in 24 hours. The eggs hatched in 14–30 days, and workers were reared to the adult stage in 44 days at summer temperatures. Alate queens and males had prepupal stages of 5·5 and 6·1 days, respectively, and pupal stages of 18·5 and 19·0 days. The ratio of queens to males was 5 : 6 for a sample of 2,632 individuals. Sexual larvae first appeared in the mounds from 2nd to 19th April, and alate forms from 7th to 18th May. The first flights occurred from 28th May to 9th June. The flights occur between 5 and 6·30 p.m. on days following rains. Alate forms were present in 25 per cent. of the colonies up to the end of December. Some winged queens, captured as they flew from the nests, laid eggs, but these were not fertile. Seven of 12 colonies from which mother queens were removed continued to produce young for over 3 years.

When disturbed, the ants swarm from their colony to attack an intruder. Both their bites and stings are painful. *Eciton* (*Neivamyrmex*) *nigrescens*, Cress., which has been observed to destroy two colonies of *S. geminata*, and *S. molesta*, Say, builds its tunnels between those of the latter.

Wilson (J. W.). **Entomological Problems in the Everglades.**—*Florida Ent.* **24** no. 1 pp. 23–26, 1 ref. Gainesville, Fla., 1941.

The geology of the Everglades area of Florida and some of the entomological problems there are briefly discussed. Effective sprays against *Laphygma frugiperda*, S. & A., on maize are too costly, and experiments show that better control is obtained by making closer plantings. *Empoasca fabae*, Harr., is present in destructive numbers usually only in the spring, while in the central part of the State it is present only in the autumn, presumably for climatic reasons. Climate is also probably responsible for periodic outbreaks of Thysanoptera, such as the onion thrips [*Thrips tabaci*, Lind.] on beans. During the spring of 1937, the tobacco thrips [*Frankliniella fusca*, Hinds] became so abundant that it was impossible to control it economically. The principal method adopted for the control of *Diatraea saccharalis*, F., on sugar-cane has been the introduction of parasites, but the population of this Pyralid is steadily increasing. Dusting with cryolite is being investigated and shows promise. It has been found that the wireworms, *Melanotus communis*, Gylh., and *Drasterius mellillus*, Say

(*Aeolus dorsalis*, Say), which are causing increasing damage to both cane and truck crops, can be controlled with several soil fumigants, but these are not economical, and the only practical measure appears to be flooding during the peak of adult emergence, or clean cultivation. Mole crickets are causing great losses in several areas, and the species present on the Experiment Station, *Gryllotalpa hexadactyla*, Perty, is increasing in abundance. The Hesperiid, *Urbanus* (*Goniurus*) *proteus*, L., is frequently a serious menace to the production of beans during autumn.

Leukel (R. W.) & Nelson (O. A.). **The Use of Chlorine Gas as a Seed Disinfectant.**—*Circ. U. S. Dep. Agric.* no. 576, 16 pp., 1 fig., 2 refs. Washington, D.C., 1940.

An account is given of experiments in the United States on the possible value of chlorine gas as a disinfectant for seed grain, in the course of which some preliminary tests were made on its toxicity to adults of *Calandra* (*Sitophilus*) *oryzae*, L., *C.* (*S.*) *granaria*, L., and *Tribolium confusum*, Duv. The insects were fumigated in Erlenmeyer flasks, about 50 in each ; the concentrations of chlorine tested were 1, 2, 5, 10, 20, 50 and 100 per cent. by volume, and the periods of exposure were 2, 5, 10, 20, 30 and 60 minutes. The ability of the insects to survive was governed largely by their size and condition, the larger and more active being more resistant than the others, and the weevils usually more resistant than *T. confusum*. The results showed a considerable amount of variation, but they indicated that some of the insects survived a concentration of 10 per cent. chlorine gas in air for 1 hour, 20 per cent. for 20 minutes, and 50 per cent. for 10 minutes. That a general mortality would be effected by running infested grain through a continuous treater in which it is exposed to less than 1 per cent. chlorine gas for about 3 minutes is highly improbable.

Knutson (H.). **The Occurrence of Larvae of the Stable Fly,** *Muscina stabulans* **(Zett.) in living Nymphs of the Grasshopper,** *Xanthippus corallipes pantherinus* **(Sc.).**—*J. Parasit.* **27** no. 1 pp. 90–91. Lancaster, Pa., 1941.

Larvae of *Muscina stabulans*, Fall., were obtained by dissection from 5 out of 7 second-instar nymphs of *Xanthippus corallipes pantherinus*, Scud., collected in Texas on 9th November 1939 and from 5 out of 11 and 11 out of 15 fourth- and fifth-instar nymphs collected in the same locality on 20th and 23rd April 1940. No larvae were present in 15 adults collected in May. Nymphs containing the larvae were distinguished by their inactivity. The number of larvae in a single nymph varied from 1 to 18, the mean being 8. They were active when dissected out and left in the laboratory cages, and three penetrated weakened nymphs of *Encoptolophus sordidus costalis*, Scud., and *Chortophaga viridifasciata*, DeG. A total of 90 larvae pupated in the cages between 29th April and 6th May ; most of them pupated at a depth of $\frac{1}{2}$–$1\frac{1}{2}$ ins. in the soil, but nine did so on the surface under dead vegetation. Adults emerged between 7th and 12th May.

The presence of larvae of *M. stabulans* in living nymphs supports the view that it is parasitic under certain conditions, possibly entering its host as a larva, and that it may represent a transitional stage in the evolution of parasitism.

[Kozhanchikov (I. V.).] **Кожанчиков (И. В.). Peculiarities in the Development of the Pupae of the Cabbage Fly (*Hylemyia brassicae*, Bch.) under different environmental Conditions.** [*In Russian.*]—*Bull. Inst. Zool. appl. Phytopath.* **7** pp. 5–14, 2 graphs, 13 refs. Leningrad, 1939. [Recd. 1941.]

An account is given of laboratory investigations carried out in Leningrad in 1938 to determine the influence of temperature and humidity on the development of the pupae of *Hylemyia brassicae*, Bch. [*cf. R.A.E.*, A **17** 141]. The observations were made on pupae from larvae that had been collected in the field in June and the beginning of July on the roots of cabbage. They showed that development proceeded at temperatures ranging from 6 to 30°C. [42·8–86°F.] and relative humidities of 6–100 per cent., provided that one of these factors was favourable. The optimum temperature was about 20°C. [68°F.] and the optimum humidity about 100 per cent., at which all the pupae survived at temperatures of 12·2 to 29°C. [53·96–84·2°F.] and 50 per cent. at 30·5°C. [86·9°F.]. At humidities of 75 and 50 per cent., the lowest percentage mortalities (52 and 84, respectively) occurred at 20°C., and this was the only temperature at which development was possible at 6 or 20 per cent. relative humidity. All the pupae died at 33·5°C. [92·3°F.] but 10 per cent. survived at 30·5°C. when the relative humidity was 75 per cent.

The threshold of pupal development was about 6°C., and, within the temperature range of 12–25°C. [53·6–77°F.], the number of day-degrees required for complete development ranged from 196 to 236°C. [352·8–424·8°F.] and averaged 210 [378]. At 100 per cent. relative humidity, the pupal stage lasted from 5 days at 29°C. to 43 days at 12·2°C.

From 12 to 20 per cent. of the pupae diapaused; this was not due to temperature, but was probably connected with the conditions under which the larvae had developed. This diapause lasted a considerable time only at a humidity of about 100 per cent. and temperatures below the optimum (20°C.). At that humidity and temperatures above the optimum, development was very much retarded, but normal development was resumed when the pupae were transferred to the optimum temperature, and the adults emerged in 10–15 days. The percentage mortality among pupae showing retarded development increased with the duration of the condition, and all died if it lasted more than a month at 30°C. or more than 2½ months at 28°C. [82·4°F.].

The fact that the pupae of *H. brassicae*, which are the hibernating stage, are favoured by high humidity and low temperatures indicates that the zone of coniferous forests would constitute a suitable habitat. Delayed development at high temperatures is probably a protective reaction against adverse conditions.

[Gerasimov (A. M.).] **Герасимов (А. М.). Diagnosis of Lepidoptera of economic Importance.** [*In Russian.*] –*Bull. Inst. Zool. appl. Phytopath.* **7** pp. 15–33, 4 figs., 4 refs. Leningrad, 1939. [Recd. 1941.]

This is the first of a proposed series of papers designed to facilitate the identification, particularly in the larval stage, of Lepidoptera that are injurious to crops in the Russian Union. It comprises descriptions of the larvae of the Pyralids, *Antigastra catalaunalis*, Dup., *Hellula undalis*, F., *Titanio normalis*, Hb., and *Pyrausta nubilalis*, Hb., and keys based largely on material in the Zoological Institute of the

Academy of Sciences in Leningrad, to the adults of various species of *Tortrix, sens. lat.* (*Archips* and *Pandemis*). The larvae of *Titanio normalis* are not injurious, as they occur on *Convolvulus*, but the cocoons in which they hibernate have sometimes been confused with those of *Loxostege sticticalis*, L.

[Zorina (L. M.).] **Зорина (Л. М.). Some Data on the Biology of the *Convolvulus* Flea-beetles.** [In Russian.]—*Bull. Inst. Zool. appl. Phytopath.* **7** pp. 34–43, 9 figs. Leningrad, 1939. [Recd. 1941.]

In the course of investigations on pests of sweet potato in the Crimea, observations on the bionomics of the flea-beetles, *Longitarsus longipennis*, Kuts., and *L. pellucidus*, Foudr., were carried out in the field and laboratory in 1933 and in the laboratory in the winter and early spring of 1934. The eggs, larvae and adults of both species are described. Besides sweet potato, *L. longipennis* occurred on *Convolvulus arvensis*, *C. lineatus* and *C.* (*Calystegia*) *sepium*, and *L. pellucidus* on all convolvulaceous plants present.

The adults of *L. longipennis* became abundant in mid-June, at which time the females had completely mature ovaries. When pairs were placed in glass jars with leaves of *Convolvulus* and filter paper or a layer of soil on the bottom, oviposition began 6–7 days later and continued for over two months, almost until the death of the females. The eggs were laid among particles of soil, or between the glass and the leaves or the stopper, mostly in batches of 3–21. The total number of eggs laid by individual females varied from 132 to 348. At 20-22°C. [68-71·6°F.] they hatched in 20-21 and 30–33 days at moderate and high humidity, respectively. Larvae placed in test tubes or jars burrowed into pieces of the main root of *Convolvulus* or into sweet potato tubers, and some of those that penetrated deeply into the latter hibernated in them.

The adults of *L. pellucidus* appeared at the end of June and were most abundant at the end of August. Females taken on 11th July had immature ovaries, and pairing and oviposition did not begin until the end of July. Eggs were laid until the beginning of October, and were observed in batches of up to 27 about an inch deep in the soil near the roots of *Convolvulus*. The total number of eggs laid in the laboratory ranged from 82 to 300. The larvae penetrated into the roots of convolvulaceous plants and sweet potato tubers, and hibernated in the latter.

Up to 1·5 per cent. of the adults of both species were parasitised by the Braconid, *Microctonus* (*Perilitus*) *basalis*, Curt., the larvae of which emerged from *L. longipennis* at the beginning of July and from *L. pellucidus* in September. Insecticides were tested in September by confining batches of beetles with sprayed or dusted foliage. A spray of 1 lb. Paris green and 2 lb. lime in 100 gals. water and one of 5 per cent. barium chloride gave 70 and 66 per cent. mortality in 6 days, as compared with 18 per cent. in the control. A dust of 5 per cent. calcium arsenite and lime (1 : 5) was much more effective, 98 per cent. of the beetles being dead 5 days after the treatment, as compared with 16 per cent. in the control; but sweet-potato plants that were dusted in the field were badly scorched and lost all their leaves. The dust could, however, be applied to convolvulaceous weeds before the flea-beetles migrate from them to sweet potato, which they did in August and especially September in 1933. The value of destroying convolvulaceous weeds is emphasised.

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